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POTATOES

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CONTENTS

POTATOES

The potato industry in Maine has advanced its production per acre from an average of 206.5 bushels for the period 1910-1919 to an average of 276.0 bushels for the period 1936-1945. A comparison of these two periods on the basis of total acreage and of total production shows an increase of approximately 31 per cent in acreage but about 76 per cent in total production. Advancements have been made also in the quality of potatoes—both seed and table stock—offered to the consumer. Maine has more by-products factories than any other state, and these provide an outlet for low grade and cull potatoes. Although potatoes cannot be produced for the price received from these factories, they do exert some stabilizing influence when properly integrated with the table and seed stock enterprises. Improvements in the quality of starch have enabled the factories to compete satisfactorily with a similar product from any other source and have enabled them to increase the returns to farmers for potatoes.

In spite of all the improvements indicated, however, the potato industry is still faced with many production and marketing problems. For instance, the consumption of potatoes per capita has gone down from 173.0 pounds per person as an average for the 10 years 1909-1918 to 127.4 as an average for the 10 years 1937-1946. This is approximately a 36 per cent reduction in per capita consumption. Either efficient production or efficient marketing alone is not the answer for the potato industry. These phases of the industry are closely interrelated and continued research on all phases is required. During the war period the main emphasis has been placed on food production. In the future more emphasis needs to be placed on consumption and marketing problems. The Research and Marketing Act known as Public Law 733 can be very helpful in expanding research, educational and marketing services, and in resolving many of the problems facing the potato industry.

The following reports on research are very largely the results for the fiscal year ending June 30, 1947. It will be seen that all phases of the industry have received attention, although funds and personnel were not available to do everything that needed doing.

DISEASES AND INSECTS

CONTROL OF LATE BLIGHT AND EARLY BLIGHT. Reiner Bonde, Everett Snyder. Late blight was practically absent from the potato fields in the vicinity of Aroostook Farm in 1946. The disease was found in several potato cull piles on June 20, but because of the unfavorable weather conditions which prevailed during the summer very little spread to commercial fields occurred. A trace of late blight was present in one unsprayed experimental plot on August 28. This source of infection did not spread and the disease remained practically absent from all of the spray plots included in the 1946 experiments and, therefore, was not a factor which influenced the yield rates.

It should be emphasized again that late-blight rot can be controlled to a large extent by thorough spraying to control the disease in the foliage and by delaying the harvesting of the crop until the plants are dead. Spraying to kill the potato foliage or for the purpose of destroying the viable late blight spores also will help to reduce losses from late blight.

Effect of Different Amounts of Lime and of DDT in Bordeaux Mixture on Yield and Control of Early Blight, Potato Flea Beetle Damage, and on Numbers of Aphids. EFFECT ON YIELD RATE. An experiment was conducted in 1946 to determine the effect different amounts of lime in the Bordeaux mixture formula have on the yield rate and the control of diseases and insects.[a]

Table 1 summarizes the yield data and the extent of injury caused by early blight and by flea beetles. The yield rate was increased, although not significantly, as the amount of lime in the Bordeaux formula was decreased. The plots sprayed with tribasic copper sulfate yielded more than those sprayed with the different Bordeaux mixtures and the unsprayed checks yielded the highest. It is thus seen that the spray mixture may depress

[a] The fungicides and insecticides included in these experiments unless otherwise stated were applied with a motor-driven power sprayer maintaining 300 pounds pressure and mounted on a truck, and equipped with a hose long enough to reach the different plots. Each plot was four rows wide and 25 feet long. Yields and disease and insect control data were taken from the two center rows of each plot. There were six replications for each treatment and the plots received six applications of spray material. Approximately 150 gallons of spray material were applied per application.

the yield rate. This reduction was less for basic copper sulfate than for the Bordeaux mixtures. Also the reduction in yield caused by spraying with Bordeaux was lowered by reducing the amount of lime in the formula. It also is of interest that in the absence of late blight the unsprayed control plots yielded more than those sprayed with either Bordeaux mixture or basic copper sulfate.

The addition of DDT increased significantly the yield rate for all of the spray materials. This increase was somewhat less for the high-lime Bordeaux and for Bordeaux-lime containing 10 pounds lime per 100 gallons spray material. The yield rate for the plots sprayed with the low-lime Bordeaux and DDT (10-5-2-100) was the highest and slightly more than for tribasic copper sulfate and DDT. None of the differences, however, are mathematically significant.

CONTROL OF EARLY BLIGHT. It can be seen from the data in Table 1 that the amount of early blight varied greatly for the different spray materials. Nearly 40 per cent of the foliage was destroyed by early blight in the plots sprayed with the high-lime Bordeaux. The amount of early blight infection was decreased to 7.3 per cent when the lime was reduced to 10 pounds in 100 gallons and to 3.0 per cent when the lime was reduced to 5 pounds per 100 gallons of spray mixture.

Ten per cent of the foliage was injured by early blight in the plots which received tribasic copper sulfate spray fungicide which was more than was present in the plots sprayed with the low-lime or medium-lime Bordeaux mixtures.

It is apparent that the addition of DDT reduced the amount of early blight for all of the spray materials. When added to the high-lime Bordeaux the amount of early blight was reduced from 39.5 per cent to 5.1 per cent and to a mere trace for the other spray mixtures.

CONTROL OF FLEA BEETLES. DDT reduced the percentage of foliage injury caused by flea beetles for all of the spray treatments. The amount of injury which was 24 and 15 per cent respectively for the high- and the medium-lime Bordeaux was reduced to .2 per cent or a mere trace when DDT was added.

The amount of injury caused by flea beetles was reduced from 9 per cent to 1 per cent when DDT was added to the low-

lime Bordeaux and from 13.5 per cent to 1.5 per cent when it was added to tribasic copper sulfate.

CONTROL OF APHIDS WITH BORDEAUX PLUS DDT.[b] The question arose as to whether DDT, when in combination with Bordeaux, loses its ability to control aphids. In the experiment described above, DDT was added to Bordeaux mixture prepared with different amounts of lime. The different Bordeaux mixtures with and without DDT were sprayed onto Katahdin potatoes and the average number of aphids per plant calculated at four different rates during the growing season.

The data pertaining to the number of aphids per plant for the different treatments are given in Table 2. The per cent control in the number of aphids that resulted from adding DDT did not materially differ for the various spray mixtures. The aphid control for DDT in the different spray mixtures on September 3 varied from 94 per cent for the high-lime Bordeaux to 96.5 per cent for the low-lime Bordeaux, compared with a 95.1 per cent control when DDT was added to tribasic copper sulfate. It is thus seen that DDT in combination with tribasic copper sulfate was not more effective in controlling aphids than it was when in combination with Bordeaux mixture.

These data indicate that DDT did not greatly lose its insecticidal properties when used with Bordeaux. It is concluded that the lower yields often obtained with DDT in Bordeaux in comparison with DDT and a neutral copper are not necessarily attributed to a reduction in its insecticidal value.

Effect on Height of Plants. It was noted that the plants sprayed with a high-lime Bordeaux, in the absence of DDT, appeared to be dwarfed and more prostrate than did the plants sprayed with a low-lime Bordeaux, or with tribasic copper sulfate. Also, the leaves of the plants that were sprayed with the high-lime Bordeaux were more or less tattered and broken with a considerable amount of early blight and dying of the lower leaves.

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[b] The buckthorn aphid, *Aphis abbreviata* Patch, was the predominating aphid species that was present in these spray plots. The green peach aphid, *Myzus persicae* (Sulz.), the potato aphid, *Macrosiphum solanifolii* (Ashm.), and the foxglove aphid, *Myzus pseudosolani* (Theob.) were relatively few in all of the spray plots conducted by these authors in 1946.

No attempt was made to determine the number of aphids per plant that were necessary for statistical differences for the different insecticidal treatments here reported.

This dwarfing, breaking, and dying of the leaves and the presence of early blight were reduced as the amount of lime in the spray formula was reduced, being very pronounced for the high-lime Bordeaux and hardly noticeable for those sprayed with the low-lime. Tribasic copper sulfate caused less injury to the foliage than did Bordeaux.

The condition of the foliage observed on the plants sprayed with Bordeaux was practically eliminated when DDT was added to the spray mixture. The plots that received DDT were all in excellent condition with no apparent injury to the foliage.

Measurements were made on September 12 to determine whether the lime content in the spray formula actually influenced the growth of the plants. The height was obtained of 60 plants for each treatment taken from the different replications. Table 3 summarizes the mean height of the plants for the different spray treatments.

The plants sprayed with the high-lime Bordeaux, in the absence of DDT, were the lowest in height, namely 16.7 inches. The height of the plants increased as the amount of lime in the spray formula was reduced. The plants sprayed with Bordeaux containing an excess of lime (10-20-100) were 1.5 inches shorter than those sprayed with Bordeaux containing the standard amount of lime (10-10-100), and 2.5 inches shorter than those sprayed with a low-lime Bordeaux (10-5-100). The plants sprayed with a low-lime Bordeaux were the same size as those that were sprayed with tribasic copper sulfate, indicating a minimum amount of plant injury. It is of interest that the tallest plants were those that received no spray treatment, the average height being 19.7 inches.

All of the spray treatments injured the potato plants. Tribasic copper sulfate and the low-lime Bordeaux caused the least amount of injury. Excessive amounts of lime in the Bordeaux mixture caused a pronounced injury characterized by dwarfing and early dying of the plants. The addition of DDT minimized or prevented entirely these injurious effects so there was little difference between the plots which received the different Bordeaux formula used in these experiments.

New Fungicides Combined with Benzene Hexachloride. CONTROL OF EARLY BLIGHT AND FLEA BEETLE DAMAGE AND EFFECT

ON FOLIAGE APPEARANCE. An experiment was conducted to determine the fungicidal value of several newly developed spray materials. Data also were obtained regarding the compatibility of these fungicides with bensene hexachloride, which is a relatively new insecticide under test on potatoes.

Table 4 gives the percentage of injury to the foliage by early blight and flea beetles for the different spray materials. Also are given the relative condition of the foliage of the potato plants which received these spray treatments.

Six applications of spray material were made during the season. The plants that received spray treatment No. 1 consisting of basic copper sulfate and DDT were the best appearing throughout the season. Spray treatment No. 5 consisting of an organic fungicide containing 32.3 per cent copper and benzene hexachloride also made a very good appearance of the foliage. Spray material No. 3, which is a similar organic fungicide but containing 33.8 per cent zinc with benzene hexachloride appeared to be inferior to spray material No. 5, which contained the copper.

The general appearance of the Bordeaux plots was somewhat inferior to that of the other spray treatments, the foliage of the plants being somewhat dwarfed and more or less broken and tattered.

Benzene hexachloride caused a definite rolling of the leaves and a chlorosis and purplish or brown discoloration of the foliage. This type of injury was especially pronounced for spray treatment No. 2.

All of the spray treatments gave good control of flea beetle injury. However, the different spray treatments differed in their ability to control early blight. Neutral copper (basic copper sulfate) both with DDT and benzene hexachloride as well as Bordeaux and DDT gave good control of this disease. The organic zinc and copper fungicide with benzene hexachloride (Spray treatments 3 and 5) and these two spray materials combined (Spray material 4) were not very effective in reducing the amount of early blight.

EFFECT ON YIELD RATE. Table 5 summarizes the yield data for the different treatments listed in Table 4.

Spray treatment numbers 4 and 5 gave the highest yield rates for this experiment. The organic zinc fungicide (Spray treatment

No. 4) and this material combined with the organic copper fungicide (Spray treatment No. 5) may prove to be valuable fungicides and they merit further experimental testing.

The severe rolling of the leaves caused by benzene hexachloride manifested for spray material No. 2 (basic copper sulfate and benzene hexachloride) apparently resulted in a slight reduction in the yield rate. Plots receiving applications of Bordeaux and DDT (Spray treatment No. 6) yielded at the same rate (namely 173 barrels or 478 bushels per acre) as neutral copper and DDT (Spray treatment No. 1), but significantly less than the organic zinc spray material (Spray treatment No. 4) with benzene hexachloride and this spray material combined with the organic copper fungicide (Spray treatment No. 5).

CONTROL OF APHIDS. All of the spray treatments containing an insecticide greatly reduced the population of aphids. (See Table 6.) The percentage of aphids killed by the different treatments in comparison with the unsprayed controls is shown in Table 7. According to these data, benzene hexachloride in combination with a neutral copper (basic copper sulfate) was about as effective in killing aphids as was DDT in combination with the same neutral copper fungicide. It can be noted further that benzene hexachloride was compatible with spray materials Nos. 3, 4, and 5 (Fungicide #629 and #308 of General Chemical Company) and greatly reduced the number of aphids per plant. Bordeaux mixture (Spray treatment No. 6) and DDT was less effective in the control of aphids in this experiment than were the other spray treatments. This was especially true for the data obtained the latter part of the season, namely September 3.

Yield Rate and Insect Control from Fungicides with and without DDT. An experiment was conducted for the purpose of determining the fungicidal and insecticidal value of a number of different fungicides and these fungicides combined with DDT (or DDD in one case).

As has been noted previously, late blight was not present in the experimental plots in 1946 and early blight in most cases was not severe. Consequently, data secured regarding the fungicidal value of the different spray materials must be considered in the light of these facts. Flea beetles and aphids were abundant and data were secured regarding the relative control of flea beetle injury and the number of aphids, and the percentage control of

these insects per plant. Table 8 summarizes the yield per acre, the relative amount of injury caused by flea beetles, the number of aphids per plant and the percentage control in the aphid population for the different spray treatments.

CONTROL OF FLEA BEETLE DAMAGE. There was a considerable amount of injury from flea beetles in the plots that did not receive applications of an insecticide. More than 60 per cent of the foliage was injured by flea beetle injury in the unsprayed controls compared with 31.0 per cent injury in those sprayed with Zinc Copper Chromate and 15.0 per cent in the plots sprayed with C.O.C.S. #7.

The injury caused by these insects was negligible when DDT was used with the copper and the zinc chromate fungicides, the injury varying from 1.0 to 1.5 per cent. The amount of injury was 2.5 per cent when DDT was used with Dithane powder. Also, it can be seen from these data that DDD was less effective in controlling flea beetles than was DDT when used with Dithane and the other fungicides included in this experiment, the injury being 6.9 per cent. Bordeaux, in the absence of an insecticide, gave fairly good control of flea beetle injury, the extent of this injury being 6.0 per cent.

CONTROL OF APHIDS. DDD with Dithane did not give good control of aphids in this experiment. According to the data in Table 9 there were 4,241 aphids per plant for this spray treatment, a minus reduction in the aphid population of 178.2 per cent.

Zinc Copper Chromate, C.O.C.S. #7, and Bordeaux in the absence of DDT permitted large increases in the aphid population in comparison with the unsprayed check. The per cent control in the number of aphids in comparison with unsprayed control was 89.7, 94.6, and 94.8 per cent when DDT was added to Zinc Copper Chromate, C.O.C.S. #7, and Bordeaux, respectively. (See Tables 8 & 9.)

EFFECT ON YIELD. The data in Table 8 show that DDT increased the yield rate for all of the fungicides. This increase was from 25 to 43 barrels (69 to 118 bushels) per acre. The smallest increase in the yield obtained from adding DDT to the fungicide was with Bordeaux mixture. Bordeaux, in the absence of DDT, gave the lowest yield rate which was 22 barrels (61 bushels) less per acre than for the unsprayed controls and the increase from adding DDT was only 25 barrels (69 bushels)

compared with an increase of 43 barrels (118 bushels) for Zinc Copper Chromate and 36 barrels (99 bushels) per acre for C.O.C.S. #7. Also, the Bordeaux and DDT spray material yielded only 3 barrels (8 bushels) more per acre than did the unsprayed controls. The relative low yields obtained on plots treated with Bordeaux and DDT cannot be attributed in this experiment to a lack in the control of aphids. It may be seen from the data that the greatest reduction in the aphid population for the experiment was with Bordeaux and DDT.

Non-Copper Fungicides. There has been an increased interest in the development of non-copper fungicides that can be used successfully for spraying potatoes. Previous studies in Maine have shown that some of these materials possess good fungicidal properties for the control of early and late blight, but that they were not effective in the control of flea beetles or the other insects. The results indicated that certain non-copper materials would be satisfactory for spraying potatoes if they were applied in combination with DDT or other insecticides.

During 1946, the non-copperous materials Phygon and Dithane with and without DDT were used for spraying potatoes in comparison with Bordeaux and with unsprayed control plots. The procedure for applying these spray mixtures was as for the experiments previously described in this report.

GENERAL APPEARANCE OF SPRAY TREATED PLOTS. The different experimental plots were examined on September 20 for the purpose of comparing the general appearance of the foliage. The foliage of the plots on which the two non-copperous fungicides were used without DDT was superior in appearance to that of Bordeaux. The plants of the Bordeaux-treated plots were more or less dwarfed and there was a considerable amount of dying of the lower leaves and the plants in some of the replications were nearly as dead as in the unsprayed controls. The plots that received Phygon and Dithane were still actively growing on that date. The plots sprayed with Dithane were slightly greener in appearance than were the Phygon-treated plots.

The addition of DDT prevented to a large extent the early dying of plants in all plots. However, plots that were sprayed with the two non-copperous fungicides in combination with DDT were superior to those sprayed with Bordeaux and DDT.

CONTROL OF EARLY BLIGHT AND FLEA BEETLE DAMAGE. Table 10 summarizes the yield data as well as the amount of injury caused by early blight and flea beetles. The percentage of early blight injury was 15.1 per cent for the unsprayed controls compared with 2.0, 7.3, and 0.9 per cent for Bordeaux, Phygon, and Dithane respectively. The addition of DDT to these fungicides reduced slightly the percentage of early blight in the Phygon- and the Dithane-treated plots.

The injury caused by flea beetles was 18.0, 24.0, and 24.0 per cent for the plots sprayed with Bordeaux, Phygon, and Dithane respectively compared with 21 per cent for the unsprayed controls. The injury caused by flea beetles was almost entirely prevented when DDT was added to the spray fungicides.

EFFECT ON THE YIELD RATE. Table 10 shows that Bordeaux and Phygon, in the absence of DDT, yielded slightly less than the unsprayed controls, although the differences are not significant mathematically. Plots sprayed with Dithane, in contrast, yielded slightly more per acre than did the control plots, but again the difference is not significant.

The addition of DDT increased the yield significantly for the three fungicides. This increase was 17, 31, and 35 barrels (47, 85, and 96 bushels) more respectively for Bordeaux, Phygon, and Dithane.

CONTROL OF APHIDS. Table 11 gives a summary of the control of aphids for the different spray applications listed in Table 10. The plants sprayed with the fungicides Bordeaux, Phygon, and Dithane (without DDT) carried many more aphids than did the unsprayed controls, a fact noted and discussed previously for other data secured in 1946. The use of these fungicides with DDT reduced the number of aphids to a point where little or no aphid injury occurred to the plants. On September 20, there were 162, 316, and 316 aphids per plant respectively on the plots sprayed with combinations of DDT with Bordeaux, Phygon, and Dithane. Comparing these fungicides with and without DDT the percentage control varied from 85.1 to 95.4. The highest per cent control for this comparison (95.4 per cent) occurred with Bordeaux and DDT.

The percentage of aphid control for the DDT spray treatments when compared with the unsprayed controls was from

74.4 per cent for Phygon and Dithane to 96.9 per cent for Bordeaux. It is noted that the percentage of control again was highest with Bordeaux and DDT. However, as has been mentioned previously, the greater reduction in the aphid population sometimes obtained with DDT and Bordeaux is not always correlated with the highest yield rate.

Dust Fungicides in Combination with DDT. This experiment was conducted with the Katahdin variety, using four-row plots each 25 feet in length and replicated four times. The plots received six applications of dust during the season. From 35 to 45 pounds of fungicide were used per acre per application applied with a hand dusting machine. The purpose of this experiment was to obtain more data regarding the compatibility of certain dust fungicides with DDT. Information also is needed regarding the proper amount of copper to include in the dust formula for the best control of early and late blight.

CONTROL OF EARLY BLIGHT AND FLEA BEETLE DAMAGE. Table 12 summarizes the yield data and the amount of injury from early blight and flea beetles for the different treatments. Late blight was absent from the potato plots included in the experiment. Early blight infection was relatively slight and probably was not a factor that greatly influenced the yield rate for the plots which received the fungicides. The disease, however, was severe in the control plots and killed 55 per cent of the foliage. The addition of DDT to the fungicide did not seem to reduce materially the amount of early blight infection. This is contrary to some of the results obtained with the spray fungicides that were compared with and without DDT.

Flea beetles caused 20.7 per cent injury to the foliage of the plots that received basic copper-talc dust or monohydrated-copper-lime dust each containing 7 per cent metallic copper. The amount of flea beetle injury was 6.1 per cent for the cuprocide-talc dust and 3.4 per cent for the basic copper-sulfate-talc dust compared with 31 per cent injury in the control plots.

The addition of DDT decreased the extent of flea beetle feeding about the same for all of the treatments where it was used. The amount of this injury varied from 3.3 per cent to 5.4 per cent and was somewhat greater than for the spray fungicides combined with DDT.

EFFECT ON YIELD. The yield for the different dust treatments are summarized in Table 12. The yield differences between fungicidal treatments in most cases are not highly significant. However, with the exception of copper lime dust, all plots which received a fungicide plus DDT, yielded more than plots with the same fungicide without DDT. The cuprocide-talc dust plots in the absence of DDT gave a higher yield rate than did the plots treated with other fungicides. Plots treated with this fungicide in the absence of DDT produced 11 barrels more per acre than those treated with the basic copper-talc dust containing five per cent metallic copper and 25 barrels more per acre than for basic copper-talc dust and the monohydrated-copper-lime dust, each containing seven per cent metallic copper. The unsprayed control plots yielded three barrels (13.75 bushels) more than the latter two dusts containing seven per cent metallic copper, and only one barrel less per acre than the plots receiving the basic copper sulfate dust containing five per cent metallic copper.

The addition of DDT increased the yield rate for all of the fungicides excepting for monohydrated-copper-lime dust where a reduction of 17 barrels per acre occurred. The reason for this decrease in the yield rate is not understood and apparently was not due entirely to differences in the control of diseases and insects.

DDT increased the yield rate 18 barrels per acre for cuprocide-talc dust, 14 barrels for basic copper-sulfate-talc dust containing 5 per cent metallic copper and 23 barrels for basic-copper-sulfate-talc dust containing 7 per cent copper. Cuprocide-talc dust and Dithane dust both with DDT gave the highest yields for these experiments, the yields being 192 barrels (529 bushels) and 191 barrels (527 bushels) respectively.

CONTROL OF APHIDS. Data were secured in 1946 regarding the relative number of aphids per plant for the different fungicidal-insecticidal dust treatments. (See Table 13.) The question arose as to whether the control obtained by applying DDT in a dust form could be confined within the areas of the respective plot treatments. Some drifting of the dust materials to adjacent plots was unavoidable. However, the amount of drift was not sufficient to materially affect the experimental results.

Aphids were fairly numerous in all of the plots where DDT was not applied. The average number per plant on September 5

in the absence of DDT varied from 1,230 for those dusted with cuprocide-talc dust to 3,507 for the plots that received monohydrated-copper-lime dust. The plants that received this latter dust fungicide had many more aphids than did the other treatments. Also it should be noted that the addition of DDT to monohydrated-copper-lime dust did not give satisfactory control of aphids, in comparison with the other dust materials, there being 1,376 per plant or slightly more than were present on the untreated control plots. The percentage control from adding DDT to monohydrated-copper-lime dust was only 61 per cent.

As a general rule the fungicidal-insecticidal dust materials included in this experiment gave somewhat less control of aphids than did the spray fungicides combined with DDT. The number of aphids on the cuprocide-talc dust plants was reduced from 1,230 per plant to 171 per plant when DDT was added, compared with 158 and 210 per plant respectively for basic copper-talc dust containing five and seven per cent metallic copper. The percentage of control in the number of aphids varied from 86 to 92 per cent for the different neutral copper dusts containing DDT compared with a control of only 61 per cent for the monohydrated-copper-lime dust material.

The Effect of a Sticker on Fungicidal and Insecticidal Value of Spray Material. The question has been asked whether the efficiency of the neutral copper fungicides can be increased by adding an adjuvant to the spray mixture.

A synthetic latex material, said to possess adhesive and fungicidal properties, was added to tribasic copper sulfate with and without DDT to determine whether its fungicidal and insecticidal properties would be increased.

CONTROL OF EARLY AND LATE BLIGHT, AND FLEA BEETLE DAMAGE. The yield data and the extent of foliage injury caused by early blight and flea beetles and the control of aphids are summarized in Table 14. The synthetic latex did not appear to possess fungicidal properties for the control of late blight. In fact, the only place where late blight appeared in this experiment, was on the plants sprayed with synthetic latex in the absence of a fungicide. This material, however, did appear to reduce the amount of early blight, the amount of injury being 7.6 per cent compared with 15.1 per cent for the unsprayed control plots.

This material in the absence of an insecticide did not control the injury caused by flea beetles. However, they were controlled when latex was combined with DDT or with DDT and the fungicide tribasic copper sulfate.

CONTROL OF APHIDS. The synthetic latex material was compatible with DDT and with the tribasic copper sulfate fungicide. Latex, in the absence of an insecticide, failed to control aphids, and DDT in combination with latex reduced the aphid population 90 per cent in comparison with the unsprayed control. (See Tables 14 and 15.)

The control of aphids in the experiment was 85 per cent when DDT was combined with tribasic copper sulfate. However, the control of aphids was only 80 per cent when latex was combined with the spray mixture of tribasic copper sulfate and DDT.

Although the synthetic latex, used in these experiments, did not control the diseases and insects it did act as an adjuvant for the spray mixtures and caused the potato foliage to possess a smooth and vigorous appearance which was reflected in the yield rate.

EFFECT ON YIELD. Spraying with latex without fungicides and insecticides and in the relative absence of the diseases increased the yield rate 11 barrels (30 bushels) per acre over yields of the unsprayed controls. Also the highest yield rate for this experiment, namely 187 barrels per acre (516 bushels) resulted from spraying with latex and DDT. This was 15 barrels (41 bushels) more per acre than when latex was added to the same spray mixture containing tribasic copper sulfate as the fungicide. However, latex added to a spray mixture of DDT and tribasic copper sulfate did not increase the yield rate.

Different Concentrations of Tribasic Copper Sulfate Spray Fungicides with and without DDT. HORSE-DRAWN SPRAY EQUIPMENT. An experiment was conducted in 1946 for the purpose of determining whether DDT would increase the fungicidal value of a neutral copper spray mixture. Early and late blight were absent from this plot experiment, so that no information was obtained regarding the relative control of these diseases for the different spray mixtures.

Table 16 summarizes the yield data that were secured from this experiment. Spraying potatoes in the absence of the foliage

diseases may reduce the yield rate significantly. The unsprayed control plots yielded at the rate of 183 barrels (503 bushels) per acre compared with a yield rate of 165 barrels (454 bushels) for the plots sprayed with the 1-100 spray mixture and 155 barrels (427 bushels) per acre for the 4-100 spray formula. The addition of DDT reduced the injury caused by the two concentrations of the fungicides so that each yielded about the same, namely, 186 and 188 barrels (512 and 517 bushels) per acre. Also, the plots sprayed with DDT, with no fungicide, yielded only one and three barrels (2.75 and 8.25 bushels) less per acre than the plots sprayed with mixtures containing one and four pounds of fungicide respectively per 100 gallons of spray mixture and only two barrels (6 bushels) or 1.1 per cent more than the unsprayed controls.

Comparison of Yellow Copper Oxide and Bordeaux Spray Fungicides in Combination with DDT Emulsions. Most of the writers' experiments with fungicides in combination with insecticide have been with spray mixtures containing a DDT suspension in the form of 50 per cent wettable powder. The results for 1945 showed that the fungicidal value of the spray material was not reduced by the addition of DDT in the form of a suspension.

An experiment was conducted in 1946, for the purpose of determining whether or not DDT in the form of emulsions would influence the fungicidal properties of Bordeaux and yellow copper oxide. The insecticide was added to yellow copper oxide as an oil emulsion containing 25 per cent DDT and to Bordeaux as a 5 per cent DDT oil emulsion. The plots were sprayed with a tractor power spray outfit. Six applications were made during the season.

Late blight was not present in these plots. Some early blight and dying of the lower leaves occurred in all of the plots which did not receive DDT. The DDT emulsions when combined with the fungicide retarded the maturity of the plants in the sprayed plots and this resulted in a corresponding reduction in the amount of early blight.

The yields for this experiment are summarized in Table 17. The plots sprayed with yellow copper oxide without DDT yielded slightly more than did Bordeaux without DDT, namely, 154 and 150 barrels (424 and 413 bushels) per acre respectively for the two spray materials.

The yellow copper oxide spray plots with DDT, yielded at

the rate of 178 barrels (490 bushels) per acre, compared with 170 barrels (468 bushels) per acre for the Bordeaux and DDT emulsion spray material.

Dust Fungicides Applied to Katahdins with Tractor Power Equipment. An experiment was conducted in 1946 for the purpose of comparing basic-copper-sulfate and yellow-copper-oxide-talc dusts containing low copper content with a standard Bordeaux mixture. The basic-copper-sulfate and the yellow-copper-oxide dusts contained 5 and 4.1 per cent metallic copper respectively. Six applications of approximately 35 pounds per acre per application were made with a tractor-drawn duster during the season. The dusts were compared in combination with DDT and without DDT.

Late and early blight were absent from these plots and no information was obtained regarding the fungicidal properties of these fungicides.

It was noted that the dusted plots that received no DDT matured and died about the same time as the unsprayed controls. The plots sprayed with Bordeaux matured a week later and were somewhat greener and actively growing when examined September 19. The addition of DDT to the dusts prolonged the growth of the plants for two weeks or more. Table 18 summarizes the yield data for this experiment. All of the fungicides, in the absence of DDT had a depressing effect on the yield rate. The unsprayed control plots yielded 9 barrels (25 bushels) more than the Bordeaux plots and 13 barrels (36 bushels) more than the dusted plots. There was no difference in the yields for the two dust fungicides, the yields being 145 barrels per acre (399 bushels) compared with 149 barrels (410 bushels) for Bordeaux and 158 barrels (435 bushels) for the unsprayed controls.

DDT increased the yield 20 barrels or 56 bushels per acre when added to the basic-copper-sulfate dust and 16 barrels or 45 bushels per acre when added to the yellow-copper-oxide dust fungicide. This increase is 13.8 and 11 per cent respectively.

BACTERIAL RING ROT. Reiner Bonde, Donald Merriam. The control of ring rot continues to be an important problem in Maine. The prevalence of the disease has been reduced so that the losses to the table stock grower are generally relatively small. However, the disease is still very important to the seed potato industry.

The strength of our seed industry depends to a large extent on our ability to maintain and produce seed stocks that are free of ring rot and the virus diseases. Therefore, every effort should be made to produce disease-free seed stocks for our growers and our seed potato markets.

Ring Rot Service to Growers. Approximately 300 samples of seed potatoes were received from growers for examination for the presence of ring rot in 1946.

A large number of additional samples of potatoes were examined for the presence of the tuber-rot nematode. Although this pest has not been found in Maine, great care should be taken that it is not introduced and permitted to become established within our State.

Development of Disease-Free Strains of Potatoes. Work is being done for the purpose of developing new strains of potatoes of the different varieties that are free of ring rot and the virus diseases. Only the highest yielding strains of potatoes will be selected for further propagation and distribution to our farmers. This project necessitates tuber indexing in the greenhouse as well as tests in the field in order to make the desired selections and progress.

Copper-Containing Fungicides as Disinfectants for Control of Ring Rot. Studies were continued in 1946 for the purpose of finding suitable disinfectants for the control of ring rot.

The results of previous studies had shown that corrosive sublimate seed potato treating solutions are very effective in destroying the ring-rot bacteria, but have the disadvantage of being expensive to use in large quantities, are very corrosive to the metal parts of the equipment used in handling potatoes and seriously injure the freshly cut potato seed pieces. Copper sulfate (2 pounds in 10 gallons of water) destroyed the bacteria quite well but also injured the cut seed pieces and is somewhat corrosive to metals.

Some data were secured in 1945 which showed that the neutral copper fungicides commonly used for spraying potatoes were less toxic to freshly cut potato seed pieces than was copper sulfate. Field experiments were conducted in 1946 for the purpose of determining whether these neutral copper fungicides could be used successfully for disinfecting contaminated seed stocks.

The ring rot seed treatment experiments conducted in 1946 included yellow copper oxide, tribasic copper sulfate, and basic copper sulfate. These disinfectants were used at three concentrations and the contaminated potato seed pieces were treated for 10- and 60-minute periods. The treated seed pieces were planted in the field and the plants that resulted were examined at harvest time for the presence of ring rot. (See Table 19.)

The neutral coppers were much less effective in controlling ring rot than was corrosive sublimate. Only one per cent of the seed pieces treated with corrosive sublimate developed ring rot compared with from 43 to 74 per cent for the seed pieces treated for 10-minute periods in the neutral copper solutions at the three concentrations.

The effectiveness of the neutral coppers as disinfecting agents was increased somewhat by increasing the concentration of the dipping solutions and by increasing the length of the treatments from 10 minutes to 60 minutes. However, even at the highest concentration and when treated for 60 minutes the amount of ring rot that was present in the plants from the treated seed pieces varied from 12 to 23 per cent. The neutral coppers here used do not appear to offer much promise as disinfectants for the control of potato ring rot.

Non-Copper Disinfectants for the Control of the Ring-Rot Organism. Twelve new disinfectants classed as types of quarternary germicides were tested regarding their ability to kill the ring-rot bacteria present on freshly cut potato seed pieces.

The data summarized in Table 20 show that none of these disinfectants was effective in killing the ring-rot bacteria at the concentration used in this experiment. The new materials, however, did appear to be effective in killing the soft rotting bacteria and the pathogenic fungi which infect the cut seed potatoes.

Boxcar Sterilization. There is a need for an effective, economical, and practical method of sterilizing railroad boxcars used for shipping seed potatoes. A material known by the trade name, "Trioxo Concentrate Powder" has been claimed by some to be well suited for the purpose of treating railroad boxcars. This material, when sprinkled onto the floors of sealed boxcars at the rate of 6½ pounds per car was said to give complete sterilization in 24 hours. It was recommended further that one tablespoonful of the material be used for each barrel of potatoes.

An experiment was conducted for the purpose of determining whether this material could be used by the methods here described for the purpose of destroying the ring-rot bacteria on the surface of cut seed potatoes. A fairly airtight wooden container, of approximately one-fourth barrel capacity was used for this experiment. One tablespoonful of "Trioxo" was dusted onto the bottom of the container. Four hundred freshly cut potato seed pieces were contaminated with the ring-rot bacteria and placed in eight bags of 50 seed pieces each on a wire frame over the dusted bottom of the container which was then sealed.

Two hundred seed pieces, or four bags of seed pieces, were removed and planted in the field after being exposed to the fumes of the dust for a period of 36 hours. Another four bags containing 200 seed pieces were removed and planted after a period of 60 hours.

The results of this experiment are summarized in Table 21. The gas treatment with Trioxo Concentrated Powder gave no appreciable reduction in the amount of ring-rot infection for the experiment here reported. This is in spite of the fact that the material was used at a rate that was several times greater than that recommended.

Breeding for Ring-Rot Resistance. Studies were continued in 1946 testing different progenies for resistance to ring rot in the field. The data secured from these experiments are summarized in Table 22. A relative high percentage of the seedlings in the progenies possessed resistance to ring rot. This percentage was greater when seedling 47102 was used as a parent than when seedling 46952 was used. The percentage of the seedlings that did not get ring rot varied from 36.6 per cent to 63.0 per cent when seedling 47102 was the resistant parent and from 6.9 to 37.6 per cent when seedling 46952 was the parent. This is in accordance with our previous results which indicate that seedling 46952 possesses less resistance than seedling 47102.

The percentage of resistant seedlings in the progenies was increased by selfing a resistant variety and by crossing two resistant varieties. When seedling 47102 was selfed, 81.6 per cent of the seedlings in the progeny were resistant compared with 54.6 per cent when this parent was crossed with the somewhat less resistant seedling 46952. It is of special interest that the Erie

variety (47101), derived from the same cross as Teton (47102), also appears to possess resistance to ring-rot infection.

Spread of Ring Rot in Seed Stocks with Known Percentages of Disease. The question often arises regarding the rate of spread of ring rot in infected seed stocks. It is known that the disease may escape being noticed for several years when present in trace amounts. These slightly infected seed stocks generally do not cause serious losses for the table stock grower until the amount of the disease has increased sufficiently to be obvious in the field and storage bin, or when the active rot causes spotting of the bags in shipment.

An experiment was begun in 1944 for the purpose of securing more information regarding the rate of spread of ring rot within seed stocks having different amounts of the disease. Diseased seed pieces were mixed with healthy seed pieces so that seed stocks were produced which contained 0, 1, 2, 3, 4, 5, and 10 per cent infection. One thousand seed pieces of each of these seed stocks were planted in 1944 and a similar lot of 1,000 seed pieces were selected at random from these respective seed stocks and replanted in 1945 and 1946. No special care was taken to avoid further contamination and seed pieces were planted by hand and received the customary cultural treatments. Data are presented in Table 23.

The healthy control seed stock contracted a trace of the disease the first year of the experiment which did not appear to have increased materially by 1946. The rate of spread in this experiment was relatively little when the amount of disease in the seed stock was less than three per cent, it being 12.1 per cent in two years when the original seed stock contained one per cent ring rot and 17.1 per cent after two years propagation when the original seed stock contained three per cent of the disease. The rapidity of disease spread was considerably higher when the seed stock contained five per cent or more of ring rot. The seed stock with five per cent ring rot had increased to 45.5 per cent within the two-year period, and the seed stock with 10 per cent ring rot had increased to 73.0 per cent in this same period.

LEAFROLL INCLUDING NET NECROSIS. Leafroll continues to be a serious problem in the potato industry and so continues to receive considerable attention.

Breeding for Leafroll Resistance.[1] AROOSTOOK FARM. 1946. G. W. Simpson, R. Bonde, F. J. Stevenson. Using green peach aphids reared on leafroll Katahdin potatoes as the means of transmitting the leafroll virus to susceptible seedlings, a number of different crosses were tested or retested for resistance to leafroll.

This method of inoculation is believed to be more severe than the field exposure method and may result in the elimination of some field resistant seedlings. On the other hand, if any seedlings survive repeated inoculation, they should be superior to seedlings showing only field resistance.

One group of seedlings, first tested in 1944, shows a few survivors after a third year in the test. Of these, 5 seedlings were considered to be sufficiently promising to be used as parents in further breeding work.

Conditions in 1946 were very satisfactory for this work and the results indicate that a much higher percentage of susceptible seedlings was eliminated than has been the case in previous years.

It is of interest to note that Triumf is of considerable value as a parent in so far as leafroll resistance is concerned.

Pedigrees, parentages, and the results of the testing to date are shown in Table 24.

In 1944, 1,784 seedlings from six crosses and one selfed line were infested with viruliferous aphids. The seedlings which became infected with leafroll as a result of these inoculations were discarded each season, and those that were healthy were planted for further observation in 1945 and 1946.

The results of this study are summarized in Table 25. It may be noted that all of the seedlings in progenies B 507, B 511, B 512, B 517, and B 518 were completely eliminated by leafroll infection during the three-year period.

Only three seedlings (about .9%) did not become infected in the progeny from cross B 522. These three seedlings apparently possess a considerable degree of resistance to leafroll infection and one, namely, B 522.33, was saved to be used as a parent for making crosses in the future.

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[1] The studies on breeding for resistance to the various diseases are cooperative with the Bureau of Plant Industry, Soils, and Agricultural Engineering of the U. S. Department of Agriculture. The new seedlings are produced in the greenhouse at Beltsville, Maryland, under the direct supervision of Dr. F. J. Stevenson.

Nearly 11 per cent of the seedlings remained free of leafroll in the progeny from selfing the Triumf variety. Four of these were saved for use as parents.

During 1945, 7,637 seedlings, the progenies from 13 crosses and three selfed lines, were infested with viruliferous aphids. The seedlings which did not contract leafroll, as a result of these inoculations, were reinfested with viruliferous green peach aphids in 1946 and the amount of leafroll that resulted was recorded.

Table 26 summarizes the results of this experiment. All of the seedlings in cross B 573 contracted leafroll as a result of the two inoculations with viruliferous aphids. Furthermore crosses B 572, B 575, B 577, B 578, B 580, B 585, B 586, B 672, and B 1129 yielded only a few seedling varieties which did not contract leafroll. However, certain crosses produced a considerably larger number of seedlings which did not get leafroll as a result of the inoculations. These are crosses B 582, B 583, and B 673. Each of these crosses was made between seedlings shown to be field-resistant at Highmoor Farm in previous years.

It should be possible to increase the degree of resistance as well as the number of resistant seedlings that are produced in the progenies by crossing and inbreeding those which now possess a certain degree of resistance.

HIGHMOOR FARM.[2] Donald Folsom. Further information was secured showing that in general there are more field-resistant seedlings in crosses made with one or both parents taken from the seedlings previously found to be field-resistant, than in crosses made with parents of other kinds. However, some of the resistant seedlings transmit resistance better than others do. (See Table 27.) Many of the most resistant seedlings, though taking much less leafroll in the Highmoor Farm field tests than standard commercial varieties, failed to show resistance in the Aroostook Farm aphid-inoculation tests, showing that the latter are probably more severe tests. However, their use as parents has given many seedlings that are resistant to aphid inoculation. (See Table 26.)

With a larger number of field-resistant seedlings available, judgment could be more severe than before with respect to vine and tuber characteristics including tuber shape, yield rate, and

[2] See abstract elsewhere in this bulletin for summary of recent years' results.

cooking quality. Crosses vary considerably in these respects. (See Table 28.) Most of the seedlings in crosses made with Green Mountain as a parent have been found to be undesirable on account of their tuber shape. Some seedlings in crosses between leafroll-resistant seedlings have cooking quality about as good as that of Green Mountain. An unusual epidemic of leaf hoppers in 1946 permitted the discarding of some seedlings for marked susceptibility to hopperburn.

Seedling 1276-185, from a cross of Katahdin with Houma, has averaged 3 per cent leafroll in five years as against 66 per cent for Green Mountain and 90 per cent for Chippewa, in the Highmoor Farm test where grown each year in rows adjacent to leafroll stock. This seedling took no leafroll on a commercial seed farm where leafroll is a perpetual nuisance in rogued Chippewa and Green Mountain. Its tubers resemble those of Chippewa closely, but run more uniform in size, and taste better when cooked. It is slightly earlier than Chippewa, keeps better in storage (slower to sprout and less susceptible to mahogany browning), and has more uniform and somewhat more vigorous vines. It might, therefore, be preferred to Chippewa in some locations.

While specific gravity may indicate certain cooking characteristics, it is not sufficient for judging cooking quality. Color, texture, and taste can be unacceptable in boiled tubers of seedlings with high specific gravity.

In addition to several resistant seedlings kept because of their value as parents, 3,426 seedlings were grown in the test plot in 1946. Of these, 2,919 were free of leafroll and were judged for vine vigor. About 2,000 were dug and judged for tuber type and yield rate. About 70 had been tested often enough to be proved resistant and were sampled for tests for yield rate on Aroostook Farm, for susceptibility to mahogany browning, for resistance to ring rot, for resistance to late blight, and for cooking quality. Some seedlings are immune to mahogany browning in cold storage where even Green Mountains are severely affected

Biology and Control of Aphids Affecting Potatoes in Maine.[3]

[3] The studies with aphids affecting potatoes and their control are made by the Maine Agricultural Experiment Station in cooperation with the Bureau of Entomology and Plant Quarantine of the Agricultural Research Administration of the United States Department of Agriculture. G. W. Simpson, C. M. Flynn, and B. A. Seaman were on the Experiment Station

W. A. Shands, G. W. Simpson, C. M. Flynn, P. H. Lung, B. A. Seaman.

INSECTICIDAL CONTROL OF APHIDS. The use of DDT on potatoes for the control of Colorado potato beetles, potato flea beetles, and aphids, as well as for the control of minor insect pests, has received wide acceptance among growers because of the material increases in yield secured through its use. As with all new materials, various questions arise as to the most economical amounts to use, how often to use the material and what benefits may be expected. Experiments conducted during 1946 were designed to answer some of these questions. Specifically, what form of DDT is best to use, what method of application will give the best results, and how frequently should applications be made.

Two series of plots in randomized blocks were planted with Katahdin potatoes for the experiment. There were four replications of each treatment. In one series of plots the major objective was to determine the aphicidal value of DDT when applied in three forms at weekly and at biweekly intervals throughout the season. The forms of DDT used in this experiment were dusts, spray suspensions made with a 50 per cent wettable powder, and spray mixtures made with an emulsifiable solution of DDT. The DDT was always applied in conjunction with a fungicide (cuprous oxide), but in plots treated biweekly with DDT the fungicide was applied by itself every other week.

In the second series of plots the major objectives were to determine the efficiency of DDT when treatment began after aphid populations were appreciable and when application of sprays was made by two kinds of machines. The plots in this experiment were treated with a fungicide only, during the early part of the season. After aphids became fairly abundant, applications of DDT were started, using the same three forms of DDT as were used in the other series of plots. The dusts were applied with a 6-row power duster, the sprays were applied in part by a conventional type of sprayer and in part by a sprayer equipped with an especially constructed boom developed by J. W. Slosser of the Soil Conservation Service as a means of increasing plant coverage.

staff; W. A. Shands and P. H. Lung were the Bureau representatives working on these problems in Maine.

Plots were 9 or 12 rows wide and 90 feet long, and all sampling was confined to a uniformly-situated, central portion of each plot. All tubers from this part were dug and weighed. For every aphid count during the summer there was recorded, by species, the numbers of aphids found on three leaves, or parts of leaves, of 25 randomly located plants in each plot. One of these was in the top third of the plant and one in each of the middle and bottom thirds. After aphid populations became large the counts were limited to the terminal and two basal leaflets of these leaves.

The figures presented in Tables 31 and 32 are average figures based on counts on 100 plants for each treatment. Where counts were made using less than whole leaves, the figures have been converted to a whole leaf basis.

In both series of plots the effectiveness of the treatments was measured by observing plant appearance during the season, by making frequent counts to determine aphid populations on the plants and by measuring the yield of tubers at the end of the season.

Data for yields and aphid populations are presented in Tables 29 and 30.

Tuber yield was significantly greater from potatoes treated with DDT and a fungicide than from those treated with a fungicide only.

It is evident that the use of DDT throughout the season beginning early in July resulted in larger yields than were obtained when application of DDT was delayed until mid-August. Relatively the increase in yield was 50 per cent greater from the plots in which treatment was started early than from those receiving DDT in August and September only.

There were no significant differences in yield between the various forms of DDT used although numerically the yields were largest where dusts were applied.

There were no significant differances in yield between the plots sprayed weekly and those sprayed biweekly, or between those sprayed with the new type of spray boom and those treated with the conventional sprayer.

A study of the data derived from the aphid population counts (Tables 31 and 32) shows somewhat different results. This

appears to indicate that yields were influenced by factors aside from insect control alone. It is also possible that below a certain point differences in degree of aphid control may not be reflected in tuber yield.

It is evident that the degree of aphid control from the application of DDT ranged from poor to excellent. Aphid control was in general better when DDT was applied weekly throughout the season than when applied every other week. In spite of this situation, no significant yield differences were found.

The aphid control obtained from either weekly or biweekly applications of DDT was far better than that secured by weekly applications begun the middle of August. This situation was reflected in the yields obtained. Very poor control of aphids was obtained from the first application of DDT with all formulations tested and with all means of application used when the first application was delayed until mid-August.

The potato aphid[4] was less effectively controlled in these tests than were the green peach[5] and buckthorn aphids.[6] This result is similar to previous experience.

There was considerable variation in the effectiveness of aphid control during the season depending upon the form in which DDT was applied. This variation was not reflected in yield. From the standpoint of aphid control, the emulsion form of DDT gave better results than were obtained with either the suspension or the dust. In most comparisons, the suspension was better than the dust.

It is also of interest that better aphid control was obtained when the emulsion form was applied using the Slosser boom than was found in the plots sprayed with a conventional machine. This difference between equipment was not evident when the suspension was used.

The aphid population was fairly high in the untreated check plots in both experiments. About half of the population near the peak of the infestation was composed of the buckthorn aphid, while another two fifths was made up of green peach aphids. As indicated above, better control of these two species was obtained than was secured with the potato aphid. It is believed that the results

[4] *Macrosiphum solanifolii* (Ashm.).
[5] *Myzus persicae* (Sulz.).
[6] *Aphis abbreviata* Patch.

to be expected from the use of DDT depend to a considerable extent on the composition of the aphid infestation.

The results obtained in this experiment on Katahdin potatoes indicate a need for early applications of DDT. They also show that, with the fungicide used, the emulsion form of DDT was the most satisfactory of the forms tested with respect to aphid control.

WEEDS AS A SOURCE OF APHID INFESTATION TO POTATOES. Experimental studies of the relation of weeds to the development of aphid infestations on potatoes were continued at Presque Isle. There was again no evidence of the overwintering of apterous aphids on biennial weeds out-of-doors.

Weeds growing in wasteland were used for a major portion of the study. The experience gained from several years' work has indicated the importance of weeds as aphid hosts when growing in such environments. Seven species of weeds[7] growing in competition in wasteland were included in the study.

The area used for this work was again divided into five plots. Successive dates of germination were assured by cultivating each plot for different periods of time. The time of final cultivation for each plot was so adjusted that the age groups of weeds present corresponded to natural weed germination following ordinary cultivation operations in cropland. The final result was a series of plots, the weeds growing in which corresponded to natural germination early in the spring, at potato planting time, and after the first, the second, and the third hilling operation in potatoes.

Weeds germinating early in the season are normally colonized by aphids which come from primary hosts. One or more wingless generations are usually produced on the weeds before winged forms develop and disperse to other weeds or potatoes.

Field counts in the weed plots were made weekly to determine, by species, the aphid population on the various weeds prior to the first appearance of winged forms. After winged forms were expected, plants were caged each week for a period of about three days. Caging was continued until the weeds no longer produced

[7] Wild radish, *Raphanus raphanistrum* L.; wild rutabaga, *Brassica campestris* L.; hemp nettle, *Galeopsis tetrahit* L.; smartweed, *Polygonum lapathifolium* L.; lamb's quarters, *Chenopodium album* L.; field sorrel, *Rumex acetocella* L.; and ox-eye daisy, *Chrysanthemum leucanthemum* L. var. *pinnatifidum* Lecoq. and Lamotte.

aphids. Each caged weed was taken, in its cage, to the laboratory where careful records of the aphids found on it could be made. All winged forms found were preserved and later identified, counted, and sexed. The field counts made early in the season consisted of twenty-five plants. Later when populations were larger and caging became necessary, the sample was ten plants.

The data obtained in this study are such that comparisons can be made to indicate the relative importance of each kind of weed in a plot as a host for both winged and wingless individuals of each aphid species. It is also possible to determine the relative importance of each age group of weeds in the production of aphids.

There has been considerable variation from year to year in the importance of various weeds. It is doubtful if the study has yet indicated the limits of this variation. Growing conditions vary considerably from season to season, a factor which influences the development of aphid populations markedly. There has been considerable variation in the length of time that weeds of different age groups have remained infested. This has influenced the total number of aphids produced. In general, however, certain trends can be observed when the data from four seasons are studied. Certain differences in response have been noted between winged and wingless forms of the same aphid species. Specifically for the buckthorn aphid, hemp nettle and smartweed, followed by wild radish and wild rutabaga have been important hosts for wingless forms, while for winged ones, smartweed and wild rutabaga, followed by hemp nettle, have been most important.

Peach aphids, both winged and wingless, have been found mostly on wild radish and wild rutabaga. Other weeds have been populated but not to as great an extent.

The potato aphid has shown much more erratic behavior from year to year. In general for wingless forms, hemp nettle, wild radish, wild rutabaga and smartweed have been important hosts, in that order. Winged aphids, however, have been produced most abundantly on wild radish and wild rutabaga, followed by hemp nettle and smartweed.

When all three species of aphids are combined, it appears that wild radish and wild rutabaga have been the more important aphid hosts.

From a consideration of the data obtained from a study of

weeds in particular age groups, some variation is again evident. On the whole, for wingless aphids, weeds germinating after the time of the second hilling in potatoes have been the most important hosts, followed closely by those which germinate after the times of the first and third hillings. In 1946, however, those germinating after the first hilling were most important, followed by those which germinated earlier than this. Winged aphids followed nearly the same pattern in 1946.

Weeds germinating at different dates have been found to be of varying importance, although in general weeds germinating after the first or second hilling operation in potatoes have been the most important aphid hosts from the standpoint of total aphids produced.

Some of the factors influencing variation in the importance of weeds from year to year are associated with the action of parasites and predators on the aphid population. Fungus diseases often, but not always, play an important part, especially toward the end of the season.

The weeds included in the study usually serve as hosts of the green peach aphid during the whole season. This is not generally true for the other species. They were important hosts for the buckthorn aphid early in the season and again late in the season. Weeds were important hosts for the potato aphid only during the latter half of the season.

Weeds growing in competition with crops, including potatoes, oats, crimson clover, mammoth clover, and English peas, have been included in the weed studies. The results of this study indicate that weeds growing in competition with potatoes were of more importance than those in other environments as hosts of the buckthorn and green peach aphids. No potato aphids were found on any of the weeds examined until midseason.

Although populations of aphids on weeds growing in competition with agricultural crops were small, there is evidence that these weeds are important in that they serve, in the early part of the season as intermediate hosts for some of the aphids. This is especially true of the green peach and foxglove aphids but less so of the other species. These weeds can support aphid populations at a time when potatoes may not be available, thus serving as an important link between primary hosts and potatoes.

Because of the increasing competition from the growing crops, weeds in cropland soon cease to be satisfactory aphid hosts. This results in the development of winged forms which fly to other secondary hosts, usually potatoes. In a study of this situation, it was found that in the case of the green peach aphid, an average of 24 days was required from the time of colonization of *Raphanus raphanistrum* until winged forms developed. For *Brassica campestris* the time required on the average was nearly 28 days. For *Galeopsis tetrahit,* a period of 33 days elapsed. In any event, weed control is of considerable importance at this period of the year. Weeds allowed to grow at this time may be a source of infestation to potatoes later in the year. In addition there is good reason to believe that the winged forms which fly from the weeds are responsible for a considerable amount of virus spread especially in unrogued fields.

Some Factors Influencing Virus Spread in 1946. The results of the Florida Test indicate that there was much less spread of leafroll than usual in certified seed fields during 1946. Because of the interest in these results, it seems desirable to consider some of the more or less evident factors involved.

Seed planted in 1946 by certified seed growers was in general better than that planted in 1945 following a year of considerable spread of leafroll. While little information is available concerning prevalence of virus diseases in table stock fields, it seems logical to assume that much of the acreage was planted in 1946 with certified seed or with seconds and pickouts from certified seed. Under such circumstances, there were probably fewer sources of infection in 1946 than in several previous years. In certified seed fields, the common practice of roguing should further have reduced sources of infection.

While the spring migration of green peach aphids began at about the usual time, the peak of the movement from primary hosts was at least a week later than it was in 1945. This delay meant that many of the winged migrants were able to find potatoes above ground and it is likely that many potatoes were colonized directly without the intervention of intermediate hosts. When conditions are favorable for rapid increases in aphid population, this situation often results in a rapid increase in population on potatoes. However, in 1946 weather conditions became unfavorable

early in July, and the rate of increase in aphid populations was appreciably retarded for a while. In fact, in two fields of untreated potatoes where counts were made throughout the season, populations actually decreased for a short time. Afterward they rose again, due in part to dispersal of winged forms from intermediate hosts. It is evident, therefore, that weather conditions were not favorable for rapid population increases of aphids on potatoes during the early part of the summer.

Another factor operating to limit spread of leafroll was the high proportion of buckthorn aphids present. Recent experience has indicated that green peach aphids are dominant in years when leafroll spreads extensively. Little, if anything, is known about the effects on the overall population brought about by competition between aphid species infesting potatoes.

The situations just described were found in fields receiving no aphicides and so are more or less indicative of conditions in general. It is known, however, that a high percentage of growers were using DDT. Experimental results have indicated that growers can be expected to get very good control of green peach and of buckthorn aphids. While grower control ranged from poor to excellent, there is reason to believe that the general level of aphid population over the whole potato-producing area was materially lowered. This fact can be established because of the greatly increased yields reported by growers who used the material. Treated potatoes doubtless continued to be repopulated by aphids (dispersal forms) coming from weeds and from untreated potatoes but the continued use of DDT prevented the rapid increase in populations found in untreated fields.

It is evident also that the rapid rise in the numbers of winged green peach aphids that could have been expected under normal conditions, never did occur, in the vicinity of Presque Isle at least. Other work has indicated the importance of winged forms in the spread of leafroll. It seems evident, then, that DDT, by delaying the development of large colonies of the green peach aphid, also limited the development of winged forms on potatoes. It also delayed the time of general flights of the aphid from potatoes to potatoes. Other studies showed that most of the leafroll infection in treated potatoes occurred late in the season in 1946.

Very little is known about the relation of the physiological

condition of a potato plant to capability of infection with leafroll. The evidence indicates that in general conditions favorable to rapid spread of leafroll did not occur until after most of the plants were no longer capable of leafroll infection by aphids. There was a period in August when growing conditions were not favorable, followed by a period when ample moisture became available. These conditions may have caused the potato plants to reach a stage, earlier than usual, in which they no longer could be infected with leafroll.

There appears to be little reason, based on one year's results, to believe that the use of DDT as such will solve the virus disease problem. It should prove to be a highly useful tool to use in connection with other common seed plot practices. It should result in a rapid improvement of the whole seed situation if table-stock growers generally will make full use of DDT and will rapidly avail themselves of good certified seed to replace stocks now carrying too much virus.

The general use of DDT by all growers in the area, especially if begun early and continued at least until the time when the peak of the aphid infestation would normally be reached, should serve, even in bad aphid years to lower the total numbers of flying aphids since fewer winged forms would be expected to develop on potatoes. It likewise should delay the period of heavy flight since that period is determined to some extent by the development of populations on potatoes. Both effects would tend to reduce the spread of leafroll appreciably from what might be expected if no DDT were used.

On the basis of information at hand there is no reason to think that the general use of DDT will have any marked effect on the aphid problem, as such, because its use is unlikely to affect aphid populations on weeds. Fall migrants from weed hosts probably will be sufficiently numerous to populate primary hosts and these colonies in turn will continue to provide for the overwintering of the aphids in the egg stage. While the serious effects of aphid infestations on potatoes may be reduced, the importance of the aphid problem from the overall standpoint may not change appreciably.

General and efficient use of DDT may extend the period during which roguing of diseased plants can be effective. It may also, in many seasons, delay the time when early harvest must be begun

with consequent gains in yield of tubers. Such a situation would be helpful also in the control of ring rot since additional time would be allowed for the development of symptoms in the plants if trace infections happen to be present.

The present conclusion is that DDT will be of material aid in maintaining seed but that it should be considered in its proper place among the other practices that have been carried out by the best seed growers in the past. The control of weeds in wasteland for example, is of even more importance where DDT is used since these plants are likely to become of major importance as sources of aphid infestation to potatoes.

Effect of DDT on Yield Rate and the Spread of Leafroll. Reiner Bonde, Everett Snyder, Geddes W. Simpson. The results of experiments conducted on Aroostook Farm in 1945 showed that applications of DDT in combinations with certain copper and organic fungicides greatly reduced the aphid population and increased the yield rate. The question immediately arose as to whether this reduction in the aphid population was associated with a corresponding reduction in the amount of leafroll spread.

In order to obtain more information regarding this question, approximately 200 tubers were taken at random at harvesting time from each of the treatments included in the experiment. The tubers were planted in the field the following spring and the percentage of leafroll for the different treatments determined. The results of this experiment are summarized in Table 33.

In the original seed stock used for this experiment about 2 per cent of the seed pieces planted were infected with leafroll. It can be noted that the unsprayed control plots had the least spread of leafroll, the amount of this disease being increased to only 7 per cent. This low percentage of disease spread was associated with the early dying of the plants in the control plots which received no fungicide or insecticide.

DDT prolonged the life of the plants when in combination with the different fungicides and the spread of leafroll was increased in all cases excepting with Bordeaux. In contrast DDT in combination with Bordeaux apparently did not increase the spread of leafroll. This might be due to the fact that the plants sprayed with Bordeaux harbored more aphids than did those sprayed with the other fungicides.

The applications of DDT in 1945 reduced the aphid population in this experiment about 80 per cent. This reduction in the number of aphids materially increased the yields, but did not reduce the spread of leafroll. Further experiments will determine whether better control of aphids and more extensive use of DDT by more farmers in the entire potato-growing area will be more effective in reducing the spread of leafroll and the other virus diseases.

INSECTICIDES FOR CONTROL OF POTATO INSECTS IN CENTRAL MAINE. John Hawkins, Roger Cobb, Geddes W. Simpson, Fay Fong Yee.[8] The 1946 experiments involved various formulations of DDT, and differences in number of applications made during the summer. The season's objective was to determine the effectiveness of DDT (1) when used during the entire season, (2) when used only as a control for the late June brood of potato flea beetles (*Epitrix cucumeris* Harr.) and Colorado potato beetles, *Leptinotarsa decemlineata* (Say), and (3) when used to control the two insects previously named, plus an application to control aphids at the time they begin to increase rapidly on potato plants. The full season program of applications included the use of both sprays and dust. Experiments were conducted on a total of seven farms. Each experimental field consisted of four replicated plots; each plot consisted of a strip which received DDT in addition to the usual applications of fungicide, and a check strip which received treatments of insecticides and fungicides, as commonly practiced by farmers during past years, but no DDT.

Weather Conditions and Insect Infestations. During May the weather conditions in central Maine were somewhat unfavorable for planting potatoes. Frequent rains caused some delay in planting, and on three farms this necessitated some delay in starting the application of spray materials. A period of cool, dry weather started in June and continued throughout the summer. Plant growth was somewhat variable. Potatoes grew rapidly until the effects of the drought began to be noticeable, then growth was very slow except for a brief period after each of the few showers which occurred during July and August.

[8] Mr. Lewis Roberts, Piscataquis County Agent, and Mr. Cecil Bradstreet, Assistant County Agent for Penobscot County, made arrangements for the farmer cooperation required to carry on the experimental work.

All of the four species of aphids[c] commonly found on potatoes were found by early July. The numbers were very small in all cases, and usually any given field contained only one of the aphid species. As the season progressed the potato aphid and the foxglove aphid became more numerous, and both species were found in all fields during August; the buckthorn and green peach aphids did not materially increase in numbers during the summer.

Leaf hoppers (*Empoasca fabae* Harris) were to be considered in this series of experiments, but their numbers were too small to warrant any consideration this season.

The lygus bug (*Lygus oblineatus* Say) was another insect to be observed in this study. This insect is very active and moves from plant to plant extensively. The DDT-treated, and the check strips, were too narrow to draw any conclusions in view of the natural activity of the insect.

Flea beetles were commonly found as soon as the potato plants emerged, and this generation lasted through June. A second brood appeared about the first of August and lasted ten days to two weeks. These insects chew small holes in the leaves, thus reducing the amount of leaf surface. The result is a smaller amount of manufactured starch. The August brood may damage plants to such an extent that the foliage turns brownish, and the plants die early. This causes a reduced yield of tubers.

The Colorado potato beetle appeared in the adult form the latter part of June. These beetles did very little direct harm, and died soon after the females deposited their eggs. Larvae began hatching by the last of June or early July. These larvae chew leaves and sometimes completely defoliate a plant before reaching the pupal stage. Affected plants usually recover but their development is retarded, resulting in a smaller crop of tubers.

Observations. Field observations were made before, and after each application of dust, or spray. Following the first application of DDT, flea beetles and adult Colorado potato beetles were seen falling off the potato plants within 20 to 30 minutes. By the following day very few of these insects were found on the plants in the treated strips. Another inspection was made just before the second

[c] The buckthorn aphid, *Aphis abbreviata* Patch.
The green peach aphid, *Myzus persicae* (Sulz.).
The potato aphid, *Macrosiphum solanifolii* (Ashm.).
The foxglove aphid, *Myzus convolvuli* (Kltb.).

treatments were applied. The strips which previously received DDT had few flea beetles and the plants showed practically no damage from the feeding of this insect; both the flea beetles and the injury they cause were fairly common on plants in the check strips, which had received no previous treatment. There was a very small number of recently hatched colonies of Colorado potato beetles on the treated strips; the check strips contained many colonies of these insects, some of which were over half grown and had caused some damage by chewing the foliage.

The effects of DDT on the potato plants varied. In Field No. 6 a noticeable difference between treated and check strips was apparent by July 10, and continued throughout the season. Plants receiving DDT were darker green, showed less insect injury, and were much smoother in appearance than those in the check strips. In the other six experiments the lack of insect injury was equally noticeable, but the other distinctions were not easily seen until a later date. As the season progressed, the plots receiving full-season treatments of DDT showed a greater variation than those which received only the two early applications of DDT. In all of the experimental plots treated strips remained in bloom longer than check strips. Treated strips matured later than check strips, with some distinction being noted in those fields which received only the two DDT treatments.

Observations regarding the effects of DDT on aphids were made in all fields except those which received only the early applications. Aphid counts were made before, and after, each application of dust or spray. The greatest difference in aphid populations between treated and check strips was noted in Field No. 7. A few potato and foxglove aphids appeared by mid-July. On the check strips there was a steady increase in numbers of individuals, which lasted through August; in the treated strips the aphid population remained exceptionally low all season, with eight aphids on one leaf, being the highest count observed. Very few green peach aphids were seen at any time. The aphid counts were highest in Field No. 5, with the potato aphid being the dominant species. DDT did not give a good control of aphids in this field, and counts were high on both treated and check strips, both before and after applications of dust. This was the only experiment which contained two varieties of potatoes, and it is interesting to note that the counts in the Katahdin plot were consistently higher than in the Houma plots.

In Fields Nos. 3, 4, and 6, the DDT controlled aphids somewhat better than in Field No. 5 but not as effectively as in Field No. 7. The residual effects of DDT apparently were greater than the immediate effects, because the difference in aphid populations on treated and check strips varied more than did the difference in populations as counted on any one treated strip before and after an application of DDT.

Comparison of Yields. In September samples of tubers were weighed to determine the effects of DDT on yields. In each plot an area was selected where conditions were as nearly even as possible in both the treated and the check strips. Across the center rows of each strip an area was measured to make the equivalent of one row 300 feet long. The tubers were dug and weighed in each of these selected areas, and a total weight determined for the four treated strips and the four check strips in each experimental field. From these figures a yield per acre was computed. The following tabulation shows the computed yield per acre for each of the fields in the 1946 test:

Type of experiment	Field	Yield in check strips	Yield in DDT strips	Difference
		Bbl.	Bbl.	Bbl.
Plots receiving only 2 early treatments of DDT	No. 1	123.2	130.9	7.7
	No. 2	174.4	175.1	0.7
Plot receiving 2 early and 2 mid-season treatments of DDT	No. 3	165.9	218.6	52.7
Plots treated with DDT all season	No. 4	179.5	205.9	26.4
	No. 5	147.5	190.4	42.9
	No. 6	152.4	183.8	31.4
	No. 7	131.1	140.0	8.9

Conclusions. An early application of DDT gave excellent results in the control of first brood flea beetles, especially in fields where the plants were large enough to permit an application of DDT to be made in late June. The second brood, which usually appears

about August 1, was noticeably smaller where steps were taken to control the overwintered beetles.

Colorado potato beetles can be effectively controlled by the use of DDT. Where this chemical was used in June to control flea beetles, it killed most of the adult Colorado potato beetles present at that time. Thus the appearance of hatched larvae was reduced and delayed to such an extent that very little damage was done by their feeding on the potato plants before the second application of DDT was made. This second application of DDT killed the young Colorado potato beetle larvae very effectively.

The use of DDT to control aphids is well worth the cost. The effectiveness of this material depends greatly on the way it is applied. To obtain maximum results, DDT should reach all parts of the plant, especially the under surfaces of the leaves.

Plants treated with DDT are stronger and more healthy than are plants not so treated. This condition is due to the fact that DDT effectively controls many insect species, thus allowing the plants to have normal growth, unhampered by the ravages of the insects. Where DDT is used plants remain green, and continue to grow after plants not treated with this material have stopped growth. Again, this may be related to its value in the control of other insect pests attacking the plants.

Yields of tubers from plants treated with DDT were greater than from untreated plants. It is not possible to attempt an explanation of the differences in yields obtained in this series of experiments because many factors enter into any such consideration, and the number of such possible variations is greater than the number of experiments performed in this project.

Tests for Translocation of DDT to Potato Tubers. B. E. Plummer, Jr. The study of the possible translocation of DDT from the tops to the tubers was continued again this year. Tubers from a plot treated with DDT and from a plot receiving no DDT were analyzed for the presence of DDT.

The tubers were washed but not peeled, dehydrated and ground for analysis. The total organic chlorine method was used for the DDT determinations. The results of these analyses showed no translocation of DDT to the tubers. This is in accord with results obtained here last year and by workers of the United States Department of Agriculture at Beltsville.

Florida Test. W. F. Porter, G. W. Simpson, E. L. Newdick.

Samples from fields growing in 1946 were tested during the winter in southern Florida. Interest in the test was evidenced by the largest entry yet recorded.

The growing season in south Florida was one of the most favorable yet encountered, permitting final virus readings by the middle of January.

The results of the test were very favorable, indicating the presence in Maine of the largest volume of good seed yet recorded in these tests. If most of this seed can be kept and planted in Maine, it will go a long way toward replacing less desirable seed stocks.

Table 34 indicates the approximate acreage by varieties tested during the past three seasons and also the results obtained as indicated by the percentage of the acreage falling into each of three seed classes.

It is at least of interest that the season just passed was the first during which the use of DDT was widespread throughout the potato-growing areas of the State. Other information indicates that DDT cannot alone account for the large volume of good seed found through the test. That it contributed to these results is not doubted.

Net Necrosis and Stem-End Browning in Storage at Different Temperatures.[9] Donald Folsom, Michael Goven. Seventy-two one-barrel composite samples of Green Mountains were made up in the usual way from the crop of 1945 and were exposed to storage temperatures of 34, 38, 44, and 50° F. There was some shifting from low to higher temperatures to imitate conditions of shipment and market. Each kind of discoloration was graded in each tuber as either "cull" or "mild," the difference depending on whether more or less than 5 per cent of the weight of the tuber had to be sliced off in order to remove all discoloration. This distinction is one made by inspectors in determining U. S. grades. Duplicate samples, kept at the same temperature (50° F.) for the same period (100 days), gave these percentages:

From Field 1, 9.8% net necrosis and 35.8% stem-end browning.
10.1% net necrosis and 34.1% stem-end browning.
From Field 2, 33.3% net necrosis and 2.0% stem-end browning.
33.4% net necrosis and 2.6% stem-end browning.

Therefore the method of sampling was satisfactory, as usual.

[9] See abstract elsewhere in this bulletin for summary of recent years' results.

As indicated in Table 35, continuous low temperature for a given period did not permit as much net necrosis to develop as appeared after the same length of time divided between low temperature in the first part and 50° in the last part. Generally, the higher the average temperature over 32° F. during the storage period, the more cull net necrosis developed, at the rate of 0.57 per cent for every excess degree Fahrenheit for tubers from one field and at the rate of 1.73 per cent for every excess degree Fahrenheit for tubers from the other field. With stem-end browning, however, exposure at the lower temperatures tended to prevent permanently any further development of the symptom after shifting of the samples to 50° F.

Each sample was examined 100 tubers at a time, taking the largest, the next largest, and so on through the sample. In this way the effect of tuber size on net necrosis could be determined. As may be seen in Table 36, the smaller the tubers the less net necrosis there was, with few exceptions. This was true in the crop from each field, at every storage temperature, and for cull, mild, or total net necrosis. For example, the part of the crop from Field 2 stored at 50° F. averaged 46.3 per cent of the tubers showing net necrosis in the largest 100, 41.5 per cent for the next largest, and 37.1, 33.0, 23.6, 21.4, and 17.9 per cent for the progressively smaller sizes. The percentage of tubers with stem-end browning tended to increase with smaller tuber size—the opposite of net necrosis, in the samples from one field, at certain temperatures. Generally the smaller the tubers, the greater was the proportion of affected ones that were in the cull class. This was less pronounced for net necrosis at 44 and 50° F. probably because there was deeper penetration and therefore more tubers with 5 per cent waste in the larger sizes at these temperatures than there were at the lower temperatures.

The foregoing results may explain why net necrosis and stem-end browning sometimes increase in transit and market, and why reports from different inspectors may disagree. Unless the storage temperature has been kept low enough for a long enough period (33° F. for 60 days), a movement of potentially affected stock from low storage temperatures to higher temperatures may be expected to show a more rapid increase in internal discoloration than parts of the same stock left in storage. The increase may be enough to cause discrepancies between inspection reports at the shipping point

and the destination. Different parts of the same storage house or storage bin may differ enough in temperature to affect the development of net necrosis and stem-end browning both in storage and following movement from storage. The effect of tuber size may easily influence the amount of cull discoloration found in different inspection samples.

EFFECT OF RATE OF FERTILIZER APPLICATION ON SPREAD OF LEAFROLL AND MOSAIC. Arthur Hawkins, G. L. Terman, G. W. Simpson. Leafroll and mosaic readings were obtained in the Florida Test for samples of tubers from three field experiments in the Sherman area of Aroostook County comparing different rates of fertilization with phosphorus and potash. The leafroll readings were all so low that no trend could be detected, and it was not possible to substantiate the observation made in 1944 on the Green Mountain variety that spread of leafroll increases with increase in the amount of phosphorus in the fertilizer. Mosaic readings were also very low, as the Katahdin variety used in the tests is fairly resistant to this disease.

In two tests of different rates of nitrogen in the fertilizer for potatoes at Aroostook Farm, leafroll readings on Cobblers and Green Mountains were also so low that no trends could be detected. Mosaic readings, however, increased slightly on Cobblers and markedly on Green Mountains with increasing rate of nitrogen. This was especially true in one test which was near a source of mosaic infection from diseased plants. In this test 25 per cent of the plants of the Green Mountain variety were infected by mosaic where 2,000 pounds of 3-8-10 was applied per acre, 28 per cent for an equal amount of 5-8-10 and 45 per cent for the same amount of 7-8-10. The Cobbler variety may have been infected less because of its earlier date of maturity and because of its greater resistance to the particular strain of mosaic involved.

SOIL FERTILITY

RESPONSE OF KATAHDIN POTATOES TO FERTILIZATION WITH PHOSPHORUS AND POTASSIUM ON SOILS HAVING DIFFERENT LEVELS OF THESE NUTRIENTS. Arthur Hawkins, P. L. Johnson, G. L. Terman, Michael Goven.[10] Nine field tests of rates of phosphorus and

[10] Studies with potato fertilizers are cooperative with the Division of Soils, Fertilizers and Irrigation, U.S.D.A. Arthur Hawkins is the representative of this Division in Maine.

eight of rates of potassium (potash) were conducted in the central Aroostook, Fort Kent, and Sherman areas of Aroostook County in 1946. In each area an attempt was made to locate tests on soils of each of three fertility levels with respect to content of phosphorus and potassium—low, medium, and high. In the phosphorus rate tests nitrogen and potash (K_2O) were applied to all plots in amount equal to 2,000 pounds of 5-0-10 per acre. In the potassium rate tests nitrogen and phosphoric acid (P_2O_5) were applied to all plots in amount equal to 2,000 pounds of 5-8-0 per acre. Fertilizer mixtures were machine-placed in side bands along the row in the planting operation by means of a specially built experimental potato planter.

Phosphorus Rate Tests in 1946. The nine phosphorus rate tests were located on soils varying in readily soluble[11] phosphorus content from 76 (very low) to 563 (high) pounds P_2O_5 per acre in the plow layer. The soil having the lower amount had been cleared for only three years, during which time it had been cropped to potatoes only once, in 1945. Uncleared soils in Aroostook County contain an average of about 35 pounds of readily soluble P_2O_5 per acre. The soils having relatively high amounts of readily soluble phosphorus have been cropped frequently to potatoes during the past 20 or more years.[12] Since the amount of phosphorus that is applied for potatoes is several times greater than the amount removed in the tubers, phosphorus has accumulated in these soils.

The yields of potatoes obtained with varying rates of fertilization with phosphorus are shown graphically in Figure 1. Increases in yield were obtained with increasing rate of application up to 200 pounds P_2O_5 per acre on soils which had a medium amount (250 pounds) of readily soluble phosphorus or less per acre. At two locations where the readily soluble phosphorus content of the soil was relatively high, 538 and 563 pounds P_2O_5 per acre, the response to phosphorus leveled off with applications of 80 to 120 pounds P_2O_5 per acre. That is, yields were no higher with an application of 2,000 pounds of 5-8-10 or 5-10-10 per acre than with 2,000 pounds of 5-4-10 or 5-6-10. The difference in response of potatoes to applied phosphorus on soils low and relatively high in readily soluble phosphorus is indicated by a comparison of the two photographs in Figure 2.

[11] Soluble in 0.002 normal sulfuric acid.

[12] Bulletin 454, Maine Agricultural Experiment Station.

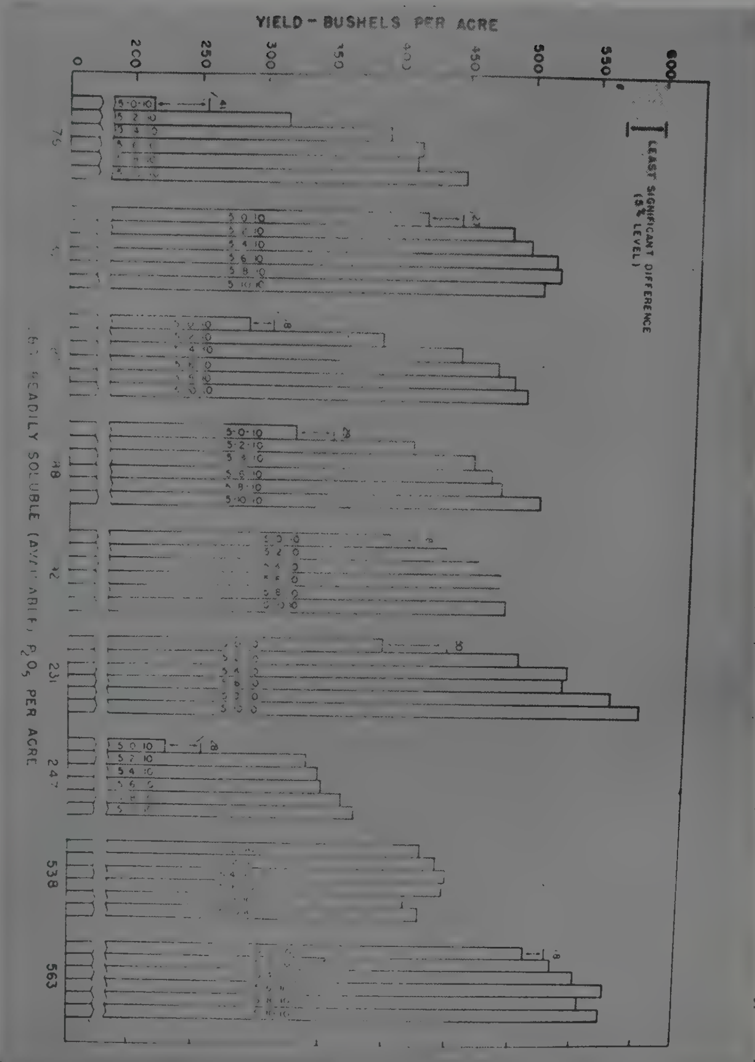

FIGURE 1. Yield of Katahdin potatoes produced in 1946 with increasing amounts of phosphorus (expressed as P_2O_5) applied in the fertilizer on soils having different levels of readily soluble phosphorus (soluble in 0.002 normal sulfuric acid). The corresponding amounts of P_2O_5 applied in 2,000 pounds of the indicated fertilizer mixture per acre were 0, 40, 80, 120, 160, and 200 pounds.

FIGURE 2. Effect of rate of applied phosphorus (expressed as P_2O_5) on growth of Katahdin potatoes in 1946, when grown on soils low and relatively high in readily soluble phosphorus.

Above: 76 lbs. readily soluble P_2O_5 in soil per acre.
Left—Fertilized with 120 lbs. P_2O_5 (2,000 lbs. 5-6-10 per acre)
Right—No P_2O_5 in the fertilizer (2,000 lbs. 5-0-10 per acre).
The yields were 415 and 213 bushels per acre, respectively.

Below: 563 lbs. readily soluble P_2O_5 in soil per acre.
Left: No P_2O_5 in the fertilizer
Right—Fertilized with 120 lbs. P_2O_5.
The yields were 512 and 551 bushels per acre, respectively.

The data obtained in 1945[13] and 1946 indicate conclusively that no increase in yield of potatoes is obtained from larger amounts of applied phosphorus than 80 to 120 pounds P_2O_5 per acre on soil relatively high in readily soluble phosphorus. The results obtained in 1946 differ from those obtained in 1945 in that small but not statistically significant increases in yield resulted from application of phosphorus up to 200 pounds P_2O_5 on soils which had medium to low contents of readily soluble phosphorus. Such increases were not obtained in 1945.

Potassium Rate Tests in 1946. The eight tests of application of different amounts of potassium in the fertilizer were located on soils of different levels of fertility ranging in content of exchangeable (available) potassium in amount equal to 160 to 907 pounds K_2O per acre in the plow layer. Potato soils differ markedly in their content of potasium available to the crop, mainly because of the past cropping practices. As is the case with phosphorus, potassium has accumulated on soils not subjected to serious erosion where less potassium has been removed in the crops than has been applied in the fertilizer or released from minerals in the soil. Uncleared soils in Aroostook County contain about 70 pounds of exchangeable K_2O per acre.[12] Soils which have been cropped frequently to potatoes and fertilized heavily often contain up to 1,000 pounds or more of exchangeable K_2O.

Results from the tests indicated that on a soil which contained 160 pounds (very low) exchangeable K_2O per acre, apparent increases in yield were obtained up to 240 pounds of K_2O applied. On two other soils containing less than 300 pounds of K_2O per acre in the plow layer, maximum yields were obtained with 180 pounds of applied K_2O (2,000 pounds of 5-8-9). Maximum yields were obtained with 120 pounds K_2O (2,000 pounds of 5-8-6) at four locations having soils ranging from 414 (medium) to 747 (very high) pounds exchangeable K_2O per acre. That is, in this range of soil fertility levels no increase in yield was obtained from 2,000 pounds of 5-8-9, 5-8-12, or 5-8-15 over the same amount of 5-8-6. At some locations an actual decrease in yield resulted from the high rates of potash application, as compared to lower rates. The yields are shown graphically in Figure 3. The difference in response of potatoes to applied potash on soils low and rather high in exchange-

[13] Bulletin 442, Maine Agricultural Experiment Station.

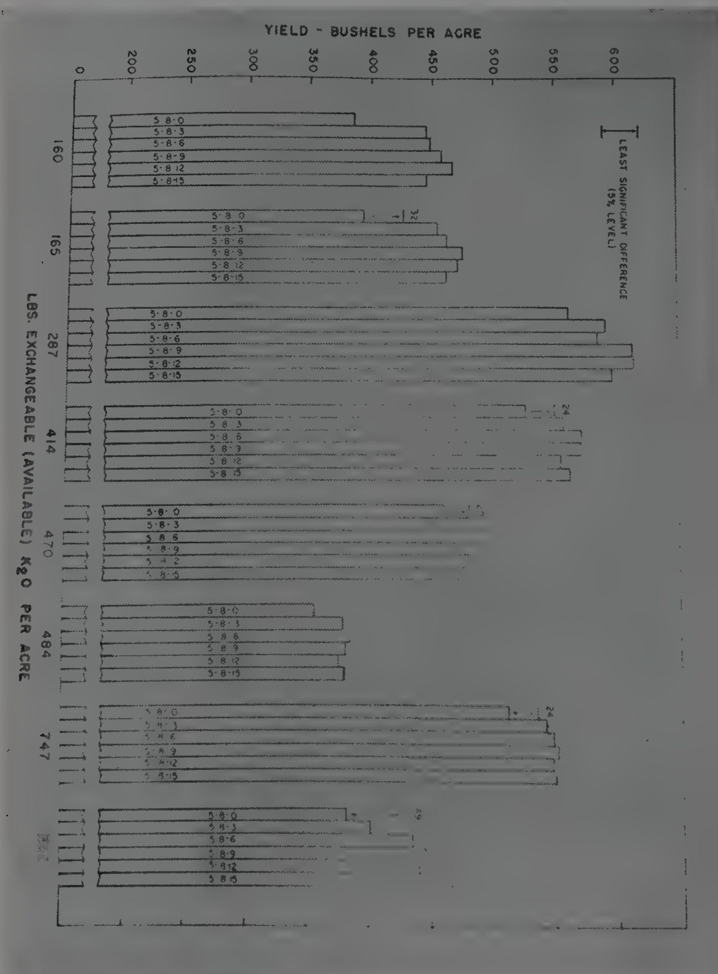

FIGURE 3. Yields of Katahdin potatoes produced in 1946 with increasing amounts of potassium (expressed as K_2O) applied in the fertilizer on soils having different levels of exchangeable (available) potassium. The corresponding amounts of K_2O applied in 2,000 pounds of the indicated fertilizer mixtures per acre were 0, 60, 120, 180, 240, and 300 pounds.

able potash is shown by the two photographs in Figure 4, which were taken on a section of the permanent fertility plots at Aroostook Farm.

FIGURE 4. Effect of the level of accumulated exchangeable potassium (expressed as K_2O) in the soil on the growth of Green Mountain potatoes in 1946 where potash was omitted from the fertilizer mixture (2,000 lbs. of 5-8-0 per acre).
Above: 170 lbs. exchangeable K_2O in soil per acre.
Below: 631 lbs. exchangeable K_2O in soil per acre.
The yields were 215 and 465 bushels per acre, respectively.

The results from potassium rate tests in 1945 and 1946 indicate that considerably more potash is being applied for potatoes on most soils of Aroostook County than is necessary for maximum yields. On soils having a high amount of residual potash, it has been definitely shown that not only is excessive application of potash often unprofitable, but actual depression of yields of potatoes may result. As shown by specific gravity data, this lack of yield response is accompanied by a decrease in the starch content of the tubers with increasing rate of potash. Although this may not be commercially important under present conditions, cooking quality of the tubers is probably appreciably lowered by the excessive rates of fertilization with potash.

Effect of Level of Accumulated Potash in the Soil on Potato Yield and Quality. G. L. Terman, Arthur Hawkins, P. L. Johnson. On one section of the permanent fertility plots at Aroostook Farm certain plots were cropped in a two-year rotation of potatoes and green manure crops from 1927 to 1944. The green manure crop was oats, peas, and vetch for the first eight years and crimson clover for the last 10 years. As listed in Table 37, certain treatments with regard to the green manure crop and addition of straw or manure resulted in wide differences in the exchangeable (available) potash content of the soil of the different plots. Potatoes on all plots were fertilized with 2,000 pounds of 4-8-8 per acre. Under this cropping system, plots from which the green manure crop was removed developed a low level of exchangeable potash in the soil, while the plots which received 20 tons of stable manure per acre for each potato crop developed a very high level. Plots receiving other treatments developed an intermediate level of exchangeable potash in the soil.

Starting in 1945 the cropping was changed to growing potatoes every year on the plots. In that year and continuing in 1946, one set of the plots received fertilizer containing no potash, 2,000 pounds of 5-8-0, while the other set received the same amount of 5-8-10. These fertilizer treatments were initiated in order to study the effect of the residual content of potash in the soil on potatoes receiving no potash in the fertilizer as compared to potatoes fertilized with potash in the form of muriate of potash.

As shown in Table 37, yields of potatoes receiving the 5-8-0 fertilizer increased markedly with increasing amount of potash in the soil, except for the highest amount, 631 pounds, which gave a

lower yield than the next lower amount, 471 pounds. Increases in yields for the plots receiving 5-8-10 fertilizer were much less marked with increase in potash content of the soil. Figure 4 illustrates the difference in growth of vines obtained on a low and a high level of potash in the soil. Specific gravity of the tubers decreased slightly with increase in the soil content of potash where potash was omitted in the fertilizer, but decreased markedly where potash was applied. As might be expected, the concentration of potassium in the potato plants increased markedly with increase in soil content of potash. (See Table 37.) The concentration of chlorides, however, was consistently low for the no-potash series and consistently higher for the potash series. The decrease in the concentration of nitrate nitrogen and magnesium in the plant with increase in uptake of potassium may be noted. The nutritional unbalance in plants fertilized with excessive amounts of potash may be the reason for the decrease in yield frequently obtained, as compared to yields obtained with lower rates of fertilization. Further chemical work on the concentration of various nutrients in potato plants as related to fertilizer practice is necessary to establish the actual relationships. Such information is essential for intelligent interpretation of the results from fertilizer experiments.

REDUCTION OF POTATO SCAB BY BROADCAST APPLICATIONS OF SULFUR AND AMMONIUM SULFATE. G. L. Terman, F. H. Steinmetz, Arthur Hawkins. In an experiment at Aroostook Farm the soil on various plots has been maintained at different pH levels by additions of ground limestone and sulfur. In 1935 replicated strips of plots received the following treatments: nothing, one ton of sulfur, and one, two, and three tons of ground limestone. No further applications of these soil amendments have been made since 1935. Potatoes have been grown on the plots in a two-year rotation with green manure crops. Very little scab developed on the tubers of the first two potato crops, even on plots on which the soil pH rose to 6.5 because of liming. With each succeeding crop potato scab has increased steadily on most of the limed plots. On the plots which received no treatment or which received sulfur, there has been practically no scab development. In 1946 many tubers from the plots which originally received three tons of limestone, were almost completely covered by scab lesions. Although there is some variation, a soil pH of approximately 5.5 has been found to be the divid-

ing line, below which clean tubers are produced and above which scab may become serious.

In the spring of 1946 broadcast applications of sulfur at three rates, 300, 600, and 900 pounds per acre, and of ammonium sulfate at three rates, 400, 800, and 1,200 pounds per acre, were made on replicated strips of plots of this experiment. Untreated strips, receiving only the usual application of fertilizer in side bands along the row for potatoes, were left for comparison. At time of harvest, four samples, each one bushel in size, of tubers from each plot were examined for scab. As shown in Table 38, all treatments of sulfur and ammonium sulfate were found to decrease scab, as compared to the untreated plots. The largest reduction occurred on the plots having a soil pH of about 5.5, which is near the critical value for scab development on this soil. On these plots scab was reduced as much as 95 per cent. On the plots having higher pH values, where scab development has been more serious, the average reduction was less, but still marked. The highest rate of sulfur or ammonium sulfate reduced scab on these plots as much as 58 per cent. Reduction in scab increased in general with increase in rate of application of these materials. Sulfur and ammonium sulfate at the rates used were about equally effective in reducing scab. Reduction in scab was accompanied by a reduction in soil pH resulting from these acidifying treatments.

As to yield of tubers, none of the treatments with sulfur resulted in a significant change, as compared with the plots receiving only the usual application of fertilizer for potatoes. Treatments with ammonium sulfate, however, resulted in marked increases in yield. Application at the 400-pound rate increased the yield on the average by 39 bushels, 800 pounds by 67 bushels, and 1,200 pounds by 82 bushels.

From the results of this experiment, it appears that a grower may practically eliminate potato scab by one rather heavy application of sulfur or ammonium sulfate on areas where there is only a light infection of the tubers by scab. On areas of heavier tuber infection further treatments will probably be necessary. If ammonium sulfate is used, the increase in yield may at least partially offset the cost of the treatment.

LIMING EXPERIMENTS IN CENTRAL MAINE. P. J. Eastman, G. L. Terman. In the spring of 1946 five liming experiments on potatoes were begun on farms in the towns of Bangor, East Sangerville,

Exeter, Lee, and Prentiss. Rates of 0, 1,000, 1,500, 2,000 and 3,000 pounds of ground dolomitic limestone per acre were worked into the soil before potatoes. Each rate was compared on replicated plots. Soil samples were taken from the plots at three dates during the growing season, and determinations of pH (acidity) were made. At time of harvest, yields were taken and the tubers examined for scab development.

In three of the experiments, no potato scab was found on any liming treatment. In the remaining two experiments there was a slight amount of scab on some tubers from all plots, but there was no indication that liming increased scab. As to the effect of lime on yield of tubers, in none of the tests did any liming treatment make a significant difference in yield. Although the pH of the soil was increased by liming, the amount of increase was much less than it is commonly thought to be. The soils before liming were all quite acid, ranging from pH 4.35 to 5.00. Liming at the rate of 1,000 pounds of limestone per acre decreased the soil acidity on the average by 0.20 pH, 2,000 pounds by 0.35 pH, and 3,000 pounds by only 0.45 pH. From these results it appears that on loam or silt loam soils having a pH of 4.8 or below, as much as 2,000 pounds of limestone can be safely applied before potatoes. On lighter, more sandy soils, however, the same amount of limestone would have a greater effect in raising the pH and might lead to more scab development than on the heavier soils.

EFFECT OF RATE OF FERTILIZATION WITH NITROGEN ON YIELD OF POTATOES FOR EARLY HARVEST. Arthur Hawkins, P. L. Johnson, Michael Goven. One disadvantage of killing or pulling potato vines in midsummer to aid in controlling leafroll and other virus diseases has been the low yields usually obtained. In 1945 an experiment on the effect of fertilization with nitrogen at rates of 60 to 120 pounds per acre was conducted on two early varieties, Cobbler and Chippewa, and on two later varieties, Katahdin and Green Mountain. All rates of nitrogen were applied with 2,000 pounds of 0-8-10 per acre. The potato crop in this experiment followed mammoth clover turned under the previous fall, which may have influenced the results. Individual rows in the experiment were harvested at three different dates, August 6, August 20, and after the plants were dead in September. For the first two harvest dates application of nitrogen at rates of 100 or 120 pounds per acre resulted in decreased yields over those obtained with 60 or 80 pounds of nitro-

gen for all of the varieties except Katahdin, which gave a slight increase in yield for the higher rates. For the final harvest, nitrogen at rates above 80 pounds gave higher yields of Chippewas and Katahdins but lower yields of Cobblers and Green Mountains. Most of the differences, however, were not statistically significant.

In 1946 a wider range of rates of nitrogen, from 40 to 140 pounds per acre, were compared on three varieties, Cobblers, Green Mountains, and Katahdins. Two experiments were conducted, one on potatoes following mammoth clover grown the previous year and another on potatoes following two years of potatoes. In neither experiment was there a significant difference in yield for the early harvest dates, August 12 and August 22, between different rates of nitrogen. In most cases, however, for the second harvest date the yield trend was upward for rates of nitrogen up to 100 or 120 pounds per acre. As is indicated in Table 39, yields at the final harvest date in September increased in most cases up to 120 pounds of nitrogen. The Cobbler and Katahdin varieties in the experiment on third-crop land gave a further but not significant increase with 140 pounds of nitrogen.

Under the conditions of the 1945 and 1946 experiments, there is little indication that any rate of nitrogen up to 100 pounds per acre delayed tuber set sufficiently to cause a significant reduction in the yields of tubers at normal early harvest dates. With the early varieties, 120 pounds reduced the early harvest yields in some cases in 1945 and 140 pounds had the same effect in some cases in 1946, both on early and final harvest yields. The data indicate that 80 to 100 pounds of nitrogen is adequate for potatoes for early harvest.

EFFECT OF RATE OF FERTILIZER APPLICATION ON SPECIFIC GRAVITY OF POTATO TUBERS. G. L. Terman, P. L. Johnson. Specific gravity of potato tubers, or their weight per unit volume as compared to water, has been found to be quite closely related to their starch and dry matter content. These are in turn usually related fairly closely to cooking quality. That is, an increase in specific gravity is accompanied by an improvement in the other properties. Specific gravity has been found to vary with variety, seasonal conditions and the amount and kind of fertilizer applied.

On samples of tubers from several field tests of rate of fertilization with nitrogen, phosphorus, and potash conducted in Aroostook County in 1946, specific gravity was determined. In general, no

difference was found in the specific gravity of tubers from plots on which the crop was fertilized with 40 to 140 pounds of nitrogen per acre applied with 2,000 pounds of 0-8-10. For rates of phosphorus equivalent to 0 to 200 pounds P_2O_5 per acre applied with 2,000 pounds of 5-0-10 fertilizer, a slight but insignificant decrease in specific gravity with increasing rate was observed. With increasing rate of potassium in the fertilizer, however, a significant decrease in specific gravity was found. As shown in Table 40, as an average of four tests, specific gravity decreased from 1.081 to 1.071 with increasing rate of potassium equivalent to 0 to 240 pounds K_2O applied with 2,000 pounds of 5-8-0. This reduction in specific gravity is approximately equivalent to a reduction of two per cent in the starch content of the tubers. In most of the tests the reduction in specific gravity was accompanied by a reduction in yield from the highest rates of K_2O. This emphasizes a need for caution in the application of excessive rates of fertilizer for potatoes.

SOIL CONSERVATION

EQUIPMENT FOR CONSERVATION FARMING. J. W. Slosser.[14] This report is a record of the progress of research investigations conducted by the Soil Conservation Service in cooperation with the Maine Agricultural Experiment Station. Project headquarters and the shop are located on the campus of the University of Maine at Orono. Field trials are conducted on a small farm near Fort Fairfield. The farm is operated jointly by the cooperators. Research studies during 1946 were devoted especially to continued field trials of adapted or altered farm equipment, tillage practices, and soil management studies. During the latter part of 1946 preliminary studies were made of the combine or harvester method of potato digging. This practice is now definitely coming into the general picture.

Equipment. POTATO DIGGER. During the winter and early spring of 1946, a one-row potato digger was constructed in the Orono shop. In designing this machine a radical departure was made from the conventional digger design in that every effort was made

[14] The research on soil conservation is cooperative with the Soil Conservation Service of the U. S. Department of Agriculture. Mr. J. W. Slosser is the Department representative located in Maine for this project.

to reduce mechanical bruising of the tubers. The machine is attached directly to the side of a tractor, forming an integral unit. Basically, the implement consists of a digging shovel, together with an elevating and separating mechanism. The shovel was constructed with a straight cutting section and with raised sides. The raised sides were designed to prevent side spilling, which is a characteristic of the conventional (D or M) blades. The shovel in this machine discharges onto an elevating conveyor belt, which, in turn, deposits its load onto a rod-link separating apron, which operates in a nearly horizontal plane.

During tests, difficulty was experienced in that the elevating belt clogged with potato vines and wet earth. The separating apron delivered potatoes very clean and with very little bruising, although the tubers were not yet mature. Since the entrance unit clogged frequently, some changes will be necessary to prevent this trouble in order to assure satisfactory operation.

POTATO HARVESTER. An experimental potato harvester sponsored by the Maine Agricultural Experiment Station was constructed in the project shop. The machine consists of a conventional two-row potato digger, to which is attached a picking "table" or belt from which stones and other extraneous materials are removed by hand picking. Although the machine was not complete at harvest time, trial runs were made near Patten, Maine. These trials of the unit indicated advantages that may be obtained by the use of this type of machine.

Some of the indicated advantages are:

1. The harvester will reduce labor costs and increase unit labor efficiency by a significant amount.

2. The harvester method of digging will permit the use of labor not physically able to pick potatoes in the conventional manner.

3. The harvester method will also permit nearly continuous field operation. This is practically impossible with conventional machinery even with an abundant labor supply.

4. The harvester method will encourage the use of bulk methods of handling and storing potatoes allowing for greater mechanization and a reduction in the labor force necessary.

SPRAYER. Spraying operations on the research farm during 1946 were continued entirely with the independent-boom sprayer developed by the project. This sprayer using farm-mixed Bordeaux

together with a commercially-prepared DDT complement gave exceptionally good disease and insect control throughout the season. It was used also in applying oil for plant killing to facilitate early harvest operations. The complete kill obtained by oil spraying was a definite indication of the coverage obtained by the unit. This sprayer is shown in Figure 5.

FIGURE 5. Project sprayer boom attached to small tractor sprayer. Each of the boom elements is independent and free to follow the ground surface. Four nozzles are used on each unit to provide for complete coverage.

Cultivation. Since many farmers have maintained that the hills produced by conventional hilling "hoes" operating across slope were undersize, an effort was made to obtain larger hills during the 1946 season. It was found that by adding three-inch "sideboards" or vertical extensions to the delivery end of the regular hoe blades that hills much larger than those normally made could easily be constructed, even on very steeply sloping land. The sideboards do not interfere with the normal operation of either the hoe or the cultivator. It was not found necessary to make any mechanical changes to the cultivator for this adaptation. A time analysis of

various field operations including cultivation of potatoes is given in Table 42.

Plowing and Listing. Mold-board plowing was continued on all sod and hayland on the research farm. Late in the year the project was able to obtain a heavy duty, two-furrow, two-way plow. The greater weight and design characteristics of this plow and the adjustments available permit good plowing on steep side slopes to 20 per cent, turning all furrows up-slope. Turning the furrow slice up-slope has obvious advantages in combating sheet erosion, and the soil movement resulting from tillage.

For the past four years, land on the Experiment Station farm following potatoes has been listed immediately following the digging operation. The lister and a listed field are shown in Figure 6. The potato vines and crop residues are, therefore, turned into the lister ridges. In the spring, as soon as the ground can be worked, it is listed again. There is a noticeable improvement in soil structure and workability which holds throughout the growing season where this practice has been followed. During 1946, it was again

FIGURE 6. Listing. This view is of a heavy 3-row lister operating over 10 in. deep. Note the ridges the lister forms. These ridges dry out and warm up early in the spring. Smaller 2-bottom listers are available for attachment to the common farm type tractor.

observed that volunteer potatoes following listing were negligible or nonexistent. This is due, no doubt, to the certain freezing of all unpicked tubers which remain in the ground over winter. The absence or control of volunteer potatoes is particularly advantageous to seed producers, since it assists in the control of leafroll and possibly other diseases as well.

Weed Control. The following method for the control of fields badly infested with so-called mustard (various varieties of wild radish, kale, and wild mustard) has been developed and studied in the project. The procedure has been to list the land immediately following potatoes, allowing the ridges to remain undisturbed until spring, when the land is relisted and the ridges broken down with a field cultivator.

When the first crop of weeds emerged, the land is disked and commercial fertilizer (6-9-15) at the rate of 800 pounds per acre is applied. Alternate tillage with the field cultivator and the disk harrow is followed each week until July or early August. The land then receives a heavy seeding (4 bushels per acre) of oats. Plowing is delayed as late as possible in order to allow the oats to mature. They are then plowed under as a green manure. The heavy seeding of oats provides for a turn-under in normal years ranging from 1.26 tons of dry material per acre to 3.2 tons per acre. This weed control practice is particularly effective when following a two-year rotation of potatoes and a close-growing legume or grass crop.

Conclusions Relative to Equipment and Equipment Operation.

1. Reasonably satisfactory mold-board plowing on cross slopes and on the contour can be obtained with a conventional plow by proper adjustment. However, much better results can be had by the use of a heavy-duty type plow, since northern Maine soils are very stony and extra strength is desirable.
2. As a basic means of preparing land other than sod, the lister is unsurpassed, since it provides a degree of protection from erosion, earlier soil working date, improved soil structure and great speed of operation. The lister operates well on steep cross slopes, is easily adjusted and is economical of operation.
3. The conventional potato planter can with moderate adaptation be used on side slopes to 18 per cent without encountering serious difficulty either with side slippage or seed piece burn.

Figures 7 and 8 are views of the altered planter and the working unit respectively.

FIGURE 7. Altered two-row planter used on project farm. The planter is hydraulically controlled from tractor seat. Note absence of hand control levers.

4. Very moderate alteration of the conventional tractor cultivator will permit entirely satisfactory operation on any tillable slope.
5. A commendable spraying job can be done with the project spray boom regardless of slope or surface. This boom is shown in Figure 5.
6. A practicable and economical method of early harvesting seed stock is available with the project sprayer. The cheap petroleum oil is applied at the rate of 35 gallons per acre with special nozzles.
7. The potato digging operation on steep slopes can be satisfactorily performed with the altered project digger shown in Figure 9.
8. A "potato harvester" or "combine" which will deliver to containers clean, quality potatoes with a minimum of bruising and

FIGURE 8. Planter working unit. This is the altered portion of the two-row planter. The view above shows one of the floating soil working units. Note shovel fertilizer openers and gage shoes, also the forward location of the point of draft.

greatly reduced hand labor will be without doubt the next introduction in the harvesting procedure.

9. The method of mustard control described in this report is practicable, effective, and economical, especially when used in connection with a two-year rotation.
10. A land operator need feel no reluctance toward accepting and establishing a complete soil and moisture conserving program because of anticipated difficult field operations.

Currently available farm equipment in proper adjustment will, if intelligently used, perform acceptable work on slopes protected by conservation measures. Usually moderate alteration or adaptation of the equipment will permit operations under extremely adverse conditions of slopes and irregularity of surface.

Potato Yields. In order to utilize available labor, potatoes on the project farm were killed by spraying with weed killer prior to frost. Since this reduced the length of the growing season by 15 to 26 days, the total yield was somewhat lower than if the potatoes

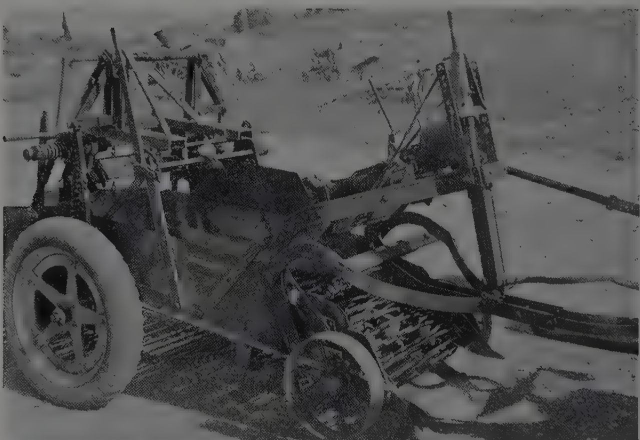

FIGURE 9. Altered potato digger adapted for work on steep side slopes. The digger is provided with power lift, self leveling shovel and tilting bed permitting level bed operation on slopes to 20 per cent.

had been allowed to mature naturally. Potato yields and land treatments on the research farm are given in Table 43. The seriously eroded terraced area (Field C) has received the addition of a large amount of organic material obtained by plowing under mature oats. Plots C-3 and C-1 where heavy organic additions were made along with erosion prevention practices yielded 198 barrels and 162 barrels respectively.

The inter-diversion area, A_3 I, with interceptions produced 7 barrels more per acre or 3 per cent more potatoes than the corresponding area, A_3 0, which did not have the supplementary protection. Contour planting and protection by diversions have maintained the yield on Field D, which produced at the rate of 172 barrels per acre. The yield for B-2 is not reported, since the seed plot occupied the greater portion of the area. The seed plot was killed for early harvest August 23, which reduced the growing period by at least 15 days. On all areas yields have been maintained or increased due to conservation of soil and moisture and good land management practices.

SEED STOCK PRACTICES

GREENSPROUTING OF SEED POTATOES. G. P. Steinbauer. Early harvesting of potatoes has become an established practice in the control of potato diseases in Maine.[15] Two factors which have retarded a wider acceptance of the early harvest program are: first, the labor and cost of destroying the vines, and second, the reduction in yield which results from early harvesting. The possibility of greensprouting seed potatoes to increase the yield of early-harvested crops has been studied in 1945 and 1946.

Greensprouting consists of placing the uncut seed tubers on a floor or on racks in thin layers, exposed to subdued, but not direct sunlight, so as to develop short, tough green sprouts. This should be done for a period of about three weeks previous to planting. When the seed pieces from greensprouted tubers are planted emergence is much more rapid than for non-greensprouted pieces and as a result the plants set tubers and mature at an earlier date than would otherwise be the case.

Greensprouting is a rather common practice in western Europe. Hardenburg[16] has made a study of greensprouting under New York conditions. As a result of his field and greenhouse tests from 1928-1931 it is clear that greensprouting not only promotes earlier emergence of the plants in the field but also results in significant increases in yield in most instances. Since differences between plants from greensprouted and non-greensprouted tubers are most marked early in the season one would expect even greater differences in yield when the crop is harvested early, rather than late.

Yield studies were made during 1945 and 1946 on greensprouted and non-greensprouted tubers of the Green Mountain, Katahdin, and Cobbler varieties. Tubers to be greensprouted were placed in layers on benches in the greenhouse three weeks previous to planting. A single thickness of burlap cloth was thrown over the tubers to cut down the light intensity. The appearance of Green Mountain tubers at the end of the greening period in 1946 is shown in Figure 10.

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[15] Schultz, E. S., Reiner Bonde, and W. P. Raleigh. Early harvesting of healthy seed potatoes for the control of potato diseases in Maine. Me. Agr. Exp. Station Bul. 427, 1944.

[16] Hardenburg, E. V. Greensprouting Seed Potatoes. Cornell Agr. Exp. Station Bul. 632, 1935.

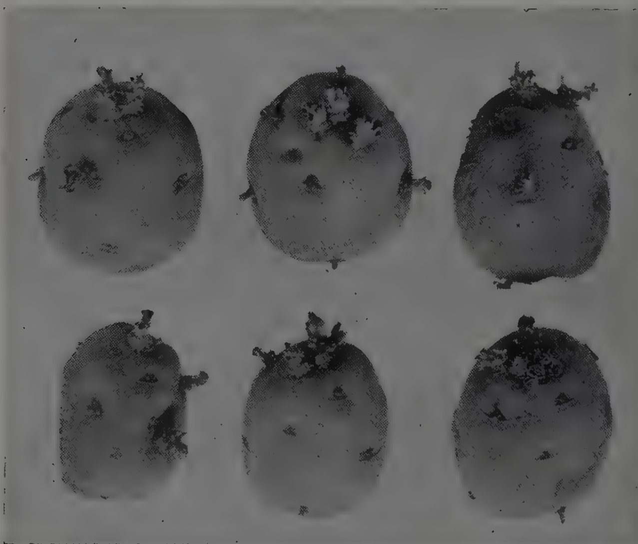

FIGURE 10. Green Mountain tubers greensprouted for three weeks.

On May 25, 1946, both greensprouted and non-greensprouted tubers were cut and planted in randomized 25-foot rows, with ten replications for each treatment. The same spacing, fertilization rates and other treatments were used on all plots. Sprouts emerged from greensprouted tubers in the field fully two weeks ahead of those from untreated tubers. On August 15th the tops of the plants were pulled and discarded, as is customary in early harvest. The tubers were dug on August 29, and weights of tubers over 1¼ inches were recorded for each plot. Results of the 1946 tests are shown in Table 44.

The results so far obtained, along with data obtained elsewhere, indicate that greensprouting may be a worthwhile practice in Maine. This is particularly true for lots to be early harvested. Because of inclement weather it is not always possible to plant the entire crop as early as desired. If a portion of the planting stock could be greensprouted it would be equivalent to planting the seed early. As pointed out by Hardenburg[16] costs of greensprouting are no greater

than treating seed for disease prevention. The only limitations are floor space and some additional labor. These should not be too serious for lots of seed of the size used to produce foundation seed. Greensprouting of seed may offset some of the difficulty in early harvest.

USE OF THIOUREA TO CONTROL SIZE OF POTATO TUBERS. G. P. Steinbauer. Medium sized potato tubers are preferred for planting stock. Oversize tubers in seed stocks represent a loss to the grower since they are usually graded out and used for the less valuable table stock or for the manufacture of starch. It has been known for some time[17] that the number of tubers and their size is dependent upon the variety, distance between seed pieces, number of stems per hill, and the growing conditions during the season. In general large seed pieces or close spacing of seed pieces tend to produce many stems per unit length of row.[18] This results in larger numbers of medium-sized tubers than would otherwise be the case. When moisture, fertility, and growing conditions are favorable this may lead to increased yields. However, the use of large seed pieces or close spacing of seed pieces is wasteful of seed. Where seed is limited in quantity or high priced other means of controlling size of tubers would be desirable.

It was pointed out by Denny[19] over twenty years ago that soaking potato seed pieces in a solution of thiourea has the peculiar effect of increasing the number of sprouts per seed piece. The effectiveness of this chemical in increasing the number of stems per seed piece can be seen from the results of recent field tests in which 250 untreated seed pieces of the Katahdin variety produced 720 stems as compared to an equal number of seed pieces soaked one hour in one per cent thiourea solution which produced 1,060 stems, an increase of 47 per cent.

The response of dormant Chippewa seed pieces to thiourea is shown in Figure 11. It is evident that thiourea not only hastens

[17] Stuart, Wm., P. M. Lombard, Margaret Connor Vosbury, G. Corder, W. C. Edmundson, C. F. Clark, and G. W. Dewey. Size of potato sets: Comparisons of whole and cut seed. U.S.D.A. Bul. 1248, 1924.

[18] Chucka, Jos. A., Arthur Hawkins, Bailey E. Brown and F. H. Steinmetz. Size of whole and cut seed and spacing in relation to potato yields. Me. Agr. Exp. Sta. Bul. 439, 1945.

[19] Denny, F. E. Effect of thiourea on bud inhibition and apical dominance of potato. Contrib. Boyce Thompson Inst. *1*:154-168, 1926.

emergence but also increases the number of sprouts per seed piece. The optimum concentration varies from 1 per cent for non-dormant cut tubers to 2 per cent for dormant tubers. Still higher concentrations tend to retard emergence.

FIGURE 11. Effect of thiourea dip treatments on typical cut pieces of dormant Chippewa tubers. Left to right, untreated, 1 per cent, 2 per cent, and 4 per cent thiourea dip for 1 hour.

The high cost of thiourea dip treatments has been a factor which has limited its use. However, the price of the pure chemical has dropped from $6.75 per pound when first used to induce multiple sprouting to about $1.20 per pound at present. During the past year comparative greenhouse tests were carried out between a

grade of thiourea[20] selling for about $.50 per pound and the pure product. The lower priced product proved equal to the more expensive one as far as effectiveness in promoting multiple sprouting. Furthermore the tests indicated that a 2 per cent solution could be used effectively for treating as high as eight lots of cut seed with a one-hour dip. By using the cheaper grade chemical and using the same bath for treating eight lots the cost per bushel of seed can be kept to around four or five cents. It appears that the cost of thiourea would be a minor factor whenever scarcity of seed or high price of seed warrants its use for controlling tuber size.

POTATO VINE KILLING

Potato Vine Killing. G. P. Steinbauer. Several petroleum fractions were studied during 1946 for potato vine killing. Products tested included diesel oil, Sovasol No. 5, emulsions containing varying proportions of diesel oil, water and Sovasol 5, and a series of five petroleum fractions[21] varying as to specific gravity, sulfur content, and content of aromatics.

Although Sovasol No. 5 and other products answering to specifications for "Stoddards Solvent" are being widely used to kill broad-leaved weeds in carrot and parsnip fields they do not completely kill potato vines. They are fairly satisfactory as defoliants. The various emulsions produced only partial kills. The petroleum fractions with the highest content of aromatics were the most effective vine killers of those studied.

When applied with ordinary sprayers using 125-150 gallons per acre, oil preparations are much more expensive than most other vine killers. To be economical special equipment would be required so as to obtain complete vine coverage with a smaller volume of spray material.

IRRIGATION

Irrigation Experiment on Potatoes. R. A. Struchtemeyer, A. Hawkins, W. C. Libby. Since in nine out of twelve years rainfall has apparently been the limiting factor in potato production in

[20] Furnished by the American Cyanamid Company.

[21] Furnished by the Shell Oil Co.

central Maine, an irrigation experiment was started in the spring of 1946 in the Town of Maxfield in Penobscot County. This project was planned to show the effects on potato yields of irrigation at the rate of one inch of water per week for the growing season as compared to no additional water when variable seed spacings (6, 8, and 10 inches) and variable rates of fertilization (1,000, 1,500, and 2,000 pounds of 8-12-16) were used. The experiment was conducted on a fine sandy loam. The variety grown was the Houma, and the potatoes were dusted throughout the season with a neutral copper/DDT dust for control of fungus diseases and insects.

Disregarding spacing and fertilization, irrigation increased yields 74.2 per cent from 70.9 barrels to 121.8 barrels per acre. This increase in yield was due primarily to an increase in size of tubers. A summary of this first year's results is shown in Table 45.

Soil moisture measurements were made throughout the growing season with gypsum blocks located at six- and twelve-inch depths below the crest of the row.

VARIETY TESTS

A REPORT ON FIVE COOPERATIVE POTATO YIELD TESTS CONDUCTED IN MAINE. Robert V. Akeley,[22] Oscar L. Wyman,[23] Carl Worthley, Paul Mosher, and Lewis Roberts. In 1946, 13 named and numbered varieties of potatoes were tested for yield and specific gravity at Presque Isle, Patten, Fort Kent, Hampden, and Dover-Foxcroft, Maine. In each location every variety or seedling was planted in a 25-hill row and replicated four times in randomized blocks. Each test was planted, fertilized, sprayed, and harvested in a manner similar to that for the area in which it was grown. At harvest time 5- to 7-pound samples of each row for each area were sent to Presque Isle, Maine, where specific gravity as a measure of dry-matter content was determined by weighing the samples by the air and water method.

The results obtained in these yield tests are given in Table 46.

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[22] Horticulturist, Division of Fruit and Vegetable Crops and Diseases, Bur. of Plant Ind., Soils, and Agr. Eng., Agricultural Research Administration, U. S. Department of Agriculture, Presque Isle, Maine.

[23] Crops Specialist, Extension Service and County Agents in Aroostook and Piscataquis counties.

The variation in the Fort Kent test was so large that the yields are of little value for comparison. This is not true for the specific gravity readings, which are included and considered reliable.

The mean yields of U.S. No. 1 tubers in bushels per acre for all varieties in the four locations are as follows: Presque Isle, 398 bushels; Patten, 499; Hampden, 308; and Dover-Foxcroft, 376. The mean variety yields of U.S. No. 1 potatoes per acre for all the locations varied from 509 bushels for seedling B 70-5 to 269 bushels for Irish Cobbler. Seedling B 69-16, Sequoia, Green Mountain, and Pontiac gave average yields of over 400 bushels per acre. The earlier-maturing varieties Pawnee and Irish Cobbler averaged less than 300 bushels per acre.

The specific gravity or density of a variety is a measure of its dry-matter content. The amount of dry-matter is closely associated with starch content. A variety high in starch content is also mealy and of good cooking quality, so the specific gravity test is used as a quick method for comparing culinary quality in potatoes, high specific gravity being associated with high quality.

The mean specific gravity for all varieties in each of the five locations is as follows: Presque Isle, 1.091; Patten, 1.080; Fort Kent, 1.070; Hampden, 1.073; and Dover-Foxcroft, 1.080. The mean specific gravity for each variety in the five locations varied from 1.086 for Mohawk and 1.085 for Green Mountain to 1.071 for Pontiac and Chippewa. Seedling B 70-5 was third in order of dry matter (sp. gr. 1.082), B 69-16 was sixth (sp. gr. 1.079), and Teton was tenth (sp. gr. 1.077).

The 1946 growing season in Maine was not considered a bad year for late blight, yet the test at Dover-Foxcroft, which was sprayed only four times, illustrates the value of growing varieties that have late-blight resistance in the tubers as well as in the vines. In Table 46, under Dover-Foxcroft, late blight rot is listed as a percentage of the total yield for each variety Thirty-eight per cent by weight of the Sequoia and 29 per cent of the Green Mountain tubers were infected with late blight rot and were a total loss. Seedling B 70-5 showed no blighted tubers, B 69-16 had a trace, and Sebago had nearly 2 per cent.

The variation in yields between areas and that of varieties within and between areas is always of interest. The information secured is helpful to the research worker who wants as many comparisons as possible on new varieties and promising seedlings. The same is

true for the grower who may be interested in the production of a variety new to him. The results of these tests will in time give some basis for recommending a change of production to new or standard varieties that are more efficient in these areas.

The great variability in dry-matter content of a variety of potatoes due to different conditions of environment and culture under which it is grown is often overlooked by the growers and the industry. The Green Mountain, for example, had a specific gravity of 1.099 as grown at Presque Isle; 1.086, at Patten; 1.076, at Fort Kent; 1.080, at Hampden; and 1.083, at Dover-Foxcroft. The dry-matter content of this variety (sp. gr. 1.076) grown at Fort Kent was lower than that of Chippewa (sp. gr. 1.080) grown at Presque Isle. The specific gravity for Green Mountain, grown at Hampden, was similar to that for Chippewa (sp. gr. 1.080) grown at Presque Isle. The dry-matter content in potatoes is greatly affected by environment. A good mealy variety often loses its mealiness when it is produced under adverse conditions for the development of that character.

The commercial value of late-blight resistance in tubers of a variety, as well as in foliage, is illustrated in a striking manner at Dover-Foxcroft. The use of better fertilizers, fungicides, and insecticides tends to lengthen the growing season for all varieties and thus to increase the chance of tuber blight infection, since complete control of late blight is seldom if ever obtained. Only a slight infection of the remaining green foliage at harvest time is necessary to inoculate the tubers.

POTATO PRODUCTS

STARCH. C. A. Brautlecht. The work on products has been very largely in an advisory capacity to starch factories and to the alcohol plant. This service over the years has aided starch manufacturers to (a) increase yields, on basis of starch content, when the latter was dropping; (b) improve quality which led to a higher starch price, more outlets and new uses, and replaced imported potato starch; (c) led to improvements in production and held labor costs per pound of starch down by use of new equipment, where labor costs represented a large proportion of total cost and was increasing at a very marked rate, as much as three or four times the

labor costs in 1926 or 1930; (d) led to building of several new continuous process factories and remodeling of others with marked improvement in working conditions for labor.

This service was helpful also in the obtaining of an industrial alcohol plant for Aroostook County. Whether or not this plant can survive under what we think of as normal conditions is a debatable question. In the sale of its product for blending in certain potable liquors, for the manufacture of certain perfumes, and for other specialty uses it is thought that the alcohol plant will be able to pay prices for potatoes comparable to those paid by starch factories.

Experimental potatoes are analyzed for starch content. Samples are obtained from Robert Akeley of the Bureau of Plant Industry, Soils, and Agricultural Engineering of the U.S.D.A. and are analyzed by Charles A. Brautlecht. The following data are for the 1946 crop:

Starch Content, 1946 Experimental Potatoes (Akeley)
November 18, 1946

Early-maturing varieties	Per cent starch	Late-maturing varieties	Per cent starch
Pawnee	18.5	792-94	18.5
I. Cobbler	16.3	792-133	18.3
Mesaba	16.0	Mohawk	18.1
DeSoto	15.7	Green Mountain	18.0
LaSalle	15.3	Katahdin	17.5
96-56	15.2	792-88	17.1
Red Warba	15.0	Cayuga	17.1
Chippewa	14.8	B70-5	16.9
SCIA27	14.7	Russe Sebago	16.5
96-44	14.6	Seneca	16.3
Triumph	14.3	Sebago	16.3
Earlaine	13.3	Ontario	16.1
46952	12.6	336-144	16.1
		Houma	15.8
		Sequoia	15.6
		Teton	15.4
		Pontiac	14.6
		Chippewa	14.5
		Kasota	14.5
		Marygold	14.3
		1276-185	14.2
		Leemaine	14.0

Composition of Dried Potatoes. B. E. Plummer, Jr. Consideration of the use of potatoes for animal feed has resulted from the large surplus harvested in 1946. Inquiries have been received as to the composition of potatoes for feeding purposes. Two samples of unpeeled potatoes were dehydrated and the usual feed analysis made.

The results are presented in tabular form.

Composition of Dried Potatoes for Feed

Sample No. and variety of potatoes	Water lost on drying	Composition of the dried, ground potatoes					
		Moisture	Protein	Ether extract	Fiber	Ash	Nitrogen-free extract
	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent	Per cent
R-922 Gr. Mountain	74.68	7.77	10.31	0.30	1.77	4.05	75.80
R-924 Katahdin	79.91	7.75	10.38	0.38	2.25	4.69	74.55

ECONOMICS OF THE POTATO INDUSTRY

The Effect of Wartime Conditions on the Production of Potatoes in Maine. William E. Schrumpf. A report on Grade Quality of Maine Potatoes has been submitted for publication. The report is based on a ten per cent sample of more than eighty thousand Federal-State inspections made in Aroostook County in the three years, 1942-1944. It presents the more important grade defects over the three-year period in relation to (1) different potato-producing areas of Aroostook County, (2) different varietal types of potatoes, (3) different size specifications, and (4) different kinds of packages.

Potato Harvesting Methods in Maine. William E. Schrumpf. This project was initiated to help solve problems presented by the changes in potato harvesting methods brought about by the wartime increase in Maine's acreage and the accompanying changes in labor and equipment requirements. The potato acreage in Maine increased from 156,000 acres before the war to more than 200,000

during the past three years. This increase has made it necessary to dig 50 to 70 million bushels of potatoes in the short period of 18 to 20 working days that Maine has in which to complete the harvest. Shortages of the usual farm help made it necessary to import labor not only from other sections of the United States but also from other countries, notably Canada and Jamaica.

An important development in harvesting equipment designed to save labor and speed up operations is the digger combine. This machine is still in the experimental stage for Maine conditions but may become an important factor affecting potato harvest operations.

Specific information was obtained concerning potato harvest operations under present conditions during the 1946 season. Points covered include the time requirements in digging, the amounts of potato bruising incurred, and the costs of operation under varying conditions. In the short time available, enumerators, including two Federal-State inspectors, worked on 40 farms presenting differences in potato varieties, soil conditions, topography, and kinds of digging equipment.

Some preliminary results of this work follow: Two-row tractor diggers were in use on 40.0 per cent of the farms enumerated, one-row tractor diggers on 37.5 per cent, one-row horse-drawn engine diggers on 15.0 per cent, and one-row digger combines on 7.5 per cent.

The average yield rate of potatoes on these farms was 134 barrels per acre. The yield rate of potatoes averaged higher on the larger farms on which information was collected than on the small farm units.[24] As might be expected, operators of large farms used a higher percentage of two-row diggers than did the operators on small farms.

Average digging was at the rate of 549 barrels or approximately 4 acres in a 9-hour day. The average number of pickers was 10 per digger. Where the two-row machines were used, digging was at the rate of 825 barrels per 9-hour day or about 5.5 acres. To pick up these potatoes required an average of 14 pickers per digger. With the one-row machines the average was 364 barrels on 3.0 acres picked up by 7 pickers.

[24] Schrumpf, William E. Costs and Practices in Producing Potatoes in Central Aroostook County, Maine, 1940. Maine Agricultural Experiment Station Bulletin 424, p. 163.

Bruising from digging averaged 9.3 per cent composed of 0.7 per cent major or grade damage and 8.6 per cent minor damage. Emptying into barrels caused an additional 4.3 per cent of bruising of which 0.8 per cent was major and 3.5 per cent minor. The Green Mountain and Sebago varieties each averaged 11.0 per cent of bruising of which about one per cent was major. The other varieties, 92 per cent of which were Katahdin, averaged 8.4 per cent bruising of which 0.6 per cent was major.

The digging cost per barrel including labor and equipment (except barrels) averaged approximately 29 cents. This cost averaged 28 cents for potatoes dug with two-row diggers and 30 cents with one-row diggers. On the farms where 2.5 acres or less were dug per day the cost was nearly 33 cents per barrel compared with about 25 cents per barrel on the farms where more than 7 acres were dug per day.

STORING, GRADING, AND SHIPPING MAINE POTATOES. Charles H. Merchant. Several phases of this study will be discussed briefly under various headings.

Potato Storage Bins. When the Federal Government established a price support program for the 1945-1946 potato marketing season, many potato storage bins were measured in the principal producing areas of the State. Measurements of bins were made for all lots of potatoes which came under the program. These measurements include the length, width, depth, and the net capacity of each bin.

The measurements of these bins furnish information which is helpful in the study of putting potatoes in storage at harvest time and of removing potatoes from storage bins during the marketing season. Any changes in the method of storing potatoes and removing potatoes from storage must take into consideration our present storage facilities. It is reasonable to expect that many of our present storage houses will be used for many years to come. Also, it should be stated that harvesting and storing methods may undergo radical changes in the next few years. In fact, growers and shippers deciding to build new storage facilities in the next few years may have difficulty in deciding on the details of the storage houses to construct.

Storage houses, both on farms and on track sidings, usually have several bins and frequently these bins differ in shape and capacity. The average dimensions of 375 farm storage bins in

Aroostook County were 32.6 feet long, 12.2 feet wide, and 11.0 feet deep. This average size bin would have a net capacity of 4,374.9 cubic feet or storage for about 1,275 barrels (11 pecks) of potatoes. Track storage bins averaged smaller and likewise they had a smaller average capacity. The average dimensions of 559 track storage bins were 25.6 feet long, 9.0 feet wide, and 11.5 feet deep. The capacity of an average size track storage bin is 2,649.6 cubic feet which would hold approximately 772 barrels (11 pecks) of potatoes when completely filled.

There were more variations in the length of farm storage bins than in the width or the depth of the bins. Farm storage bins in the St. John area were the shortest, averaging 29.1 feet in comparison with 33.9 feet for the Houlton area and 42.5 feet for the Ashland area. The width of bins ranged from an average of 10.7 feet for the Houlton area to 13.3 feet for the St. John and Presque Isle areas. There were some variations in the depth of farm storage bins ranging from an average of 9.3 feet in the Ashland area to 12.3 feet in the St. John area, with 10.3 feet for the Presque Isle and the Houlton areas.

The average length of track storage bins throughout Aroostook County showed only small variations, ranging from 24.5 feet for the Houlton area to 26.1 feet for the St. John area. Likewise the width of track storage bins showed very little variation between areas. However, the average depth of bins varied by areas from 10.6 feet for the Presque Isle area to 13.7 feet for the Ashland area with the Houlton area 11.2 feet and the St. John area 12.5 feet. (See Table 47.)

Nearly 72 per cent of the farm storage bins have a storage capacity of 1,000 to 5,000 cubic feet or about 290 barrels to about 1,450 barrels. Less than 3 per cent of the bins have smaller capacities and nearly 26 per cent have larger capacities. With track storage, 89 per cent had a storage capacity of 1,000 to 5,000 cubic feet or about 290 barrels to about 1,450 barrels. Somewhat over 4 per cent of the track storage bins had less than 1,000 cubic feet capacity and 7 per cent had over 5,000 cubic feet capacity. (See Table 48.)

Storing and Taking Potatoes Out of Storage. For the past two seasons information has been collected on storing potatoes in farm and track storage houses in Aroostook County. Also, information was collected for the last marketing season on taking potatoes

out of storage and similar information is being collected this marketing season.

The exact time was recorded in storing potatoes in 41 farm storages and 74 track warehouses in the fall of 1945. While the potatoes were being stored, Federal-State inspectors examined the potatoes for the amount of bruising occurring to the potatoes in the storing operation. Also, a record was made of the number of potatoes of different sizes. The latter information was assembled to determine whether there existed any relationship between size of tubers and the amounts of bruising occurring in storing potatoes by different methods. Also, this information should be helpful in any revision of grades and standards that may be made in the future. Similar information was obtained in the fall of 1946 in both farm and track storage houses in Aroostook County.

The average time required to unload and store a load of 32 barrels of potatoes in 1945, using an average of 2.4 men, was about 11 minutes in farm storages. In track storages the average time required was slightly over 11 minutes per load of 32 barrels using an average of 2.8 men when potatoes were rolled in on planks and 16 minutes per load of 40 barrels using an average of 3.5 men when barrels were hoisted to second floor and potatoes dumped through a tube. Considerable variation in the time required to store a load of potatoes was observed due to facilities used in storing, the storage house, whether a bin was being started or nearly full, and the men doing the storing.

The amount of bruising occurring to potatoes during the storage operation varied considerably between storage houses and even within the same house with different loads of potatoes. The average amount of bruising in farm storage houses in the fall of 1945 was about one per cent of grade injury and was less than one per cent for potatoes stored in track storages. The causes of this damage to potatoes in storing are being studied and it is hoped that changes may be suggested to reduce the losses now occurring.

As previously indicated, information is partly assembled on the time necessary to remove potatoes from storage and the amount of bruising resulting in the operation. The information shows that five operators shovelled and one used a conveyor to take potatoes out of six farm storages during the 1945-1946 marketing season. For 30 track storages, 28 operators shovelled the potatoes and 2 operators bled the bin. While the samples for both farm and track

storages may be too small to be truly representative, it is recognized that most operators shovel the potatoes either into barrels or directly onto a grader. The average time required for the equivalent of one man to shovel 100 barrels of potatoes was 4.6 hours. The amount of bruising occurring in shovelling potatoes into barrels or into a grader averaged nearly .3 per cent major or grade bruises and 5.0 per cent minor bruises. When more complete information is made available, some suggestions for reducing the amount of bruising will be given.

It seems possible to increase the efficiency in removing potatoes from storage by the use of mechanical devices and possibly by some changes in bin construction. Also, it is not outside the realm of possibility to change the method of putting potatoes into storage as well as the method of removing potatoes from storage. However, this problem needs much further study and is being studied on a limited scale at the present time.

Grading Potatoes. The grading of Maine potatoes has taken on increased importance during recent years as the volume of consumer packages has increased. Even from casual observation it is evident that the development of the grading equipment has not kept pace with the marked upward trend in consumer packages. It would seem desirable to further mechanize the grading operations and eliminate as much as possible of the expensive hand labor now used in grading. Information on grading operations was obtained during the 1945-1946 marketing season and further information will be assembled for the 1946-1947 season.

The time required to grade and package potatoes in Maine varied widely during the 1945-1946 season due to the quality of potatoes graded, size of packages into which the potatoes were graded, the size and operation of the grading equipment, and the number and the quality of the crew. However, analysis of a limited number of records taken last season shows that an equivalent of one man on the average working one hour was necessary to grade and package 11 hundredweight of potatoes in 10- and 15-pound packages and 20 hundredweight of potatoes in 50- and 100-pound containers. When a Super Spud grader is used the shipper may be putting up two sizes of potatoes in 10-pound packages and one size in 50-pound packages at the same time. The information being collected this marketing season will supplement that of last year and permit more complete analysis of each operation. The

Maine Potato Growers, Inc. is cooperating with the Maine Experiment Station in the problem of increasing the efficiency of grading, packaging, and loading potatoes on cars.

Information on the amount and extent of bruising was obtained during the grading operation. Samples of potatoes were taken at the hopper of the grader, from the grading table, and later from the packages. There was considerable variation in the amount of bruising due largely to the care of the man grading the potatoes and whether or not the grader was adequately padded. For the 42 records taken in the 1945-1946 season the average amount of bruising was .5 per cent of grade damage and 6.0 per cent of minor bruises at the hopper of the grader. An additional .3 per cent of grade damage and 7.5 per cent of minor bruises occurred in potatoes passing over the grading table. The man at the grading table picked out the badly damaged potatoes but some, no doubt, escaped his eye, and some potatoes were bruised in the packaging operations. The average amount of bruised potatoes in the packages was .9 per cent major damage and 14.5 per cent minor injury.

Loading Potatoes on Cars. Potatoes are loaded into cars either directly from the grader or from stored graded potatoes in track storage houses. There is very limited equipment for loading potatoes in cars. Most of the potatoes are carried into the car by the grading crew or conveyed into the car by a hand truck or wheelbarrow. Information on the loading of a few cars seemed to favor, as far as time on the part of the men was concerned, carrying potatoes into the car rather than using hand trucks or wheelbarrows. However, the information being obtained this season is needed before definite comparisons can be made. It is possible that both the above methods of loading cars are relatively inefficient compared to some other method or methods that may be suggested when the situation is more fully explored.

RECENT PUBLICATIONS OF INTEREST TO POTATO GROWERS

BULLETINS

No. 439. Size of Whole and Cut Seed and Spacing in Relation to Potato Yields.

No. 444. Recent Changes in Production Methods on Maine Potato Farms.

No. 446. Potato Yellowtop and Unmottled Curly-Dwarf in Maine.
No. 447. The Effect of Fertilizer Practice Including the Use of Minor Elements on Stem-end Browning, Net Necrosis, and Spread of Leafroll Virus in the Green Mountain Variety of Potato.

MISCELLANEOUS PUBLICATIONS

No. 602. Eradication of Certain Maine Weeds, an Important Step in Control of Potato Diseases Spread by Aphids.
No. 604. Storage of the 1946 Maine Potato Crop.

ABSTRACTS OF ARTICLES PUBLISHED IN PERIODICALS

A VIRUS DISEASE OF THE POTATO TRANSMITTED BY THE ASTER LEAFHOPPER[25]

The aster leafhopper, *Macrosteles divisus,* transmitted by artificial inoculations a virus disease of the potato which appears to be different from purple-top wilt. The symptoms of the disease are apparent toward the end of the growing season and are characterized by a slight dwarfing and by a rolling of the upper leaves of the plant similar to that often associated with rhizoctonia stem rot and other diseases. The stems of the pigmented varieties develop a purplish color. The internodes may become shortened, and the nodes enlarged. The plants do not wilt or die prematurely, and a pronounced necrosis of the vascular bundles near or at the ground line does not occur. None of the tubers from diseased plants becomes flabby or develops vascular discoloration. They germinate normally and the disease is perpetuated through the seed tubers. This disease has been found in potato fields in Aroostook County, Maine, but apparently is of little economic importance. The disease is very similar to apical leafroll, previously described by Schultz and Bonde. (Maine Agricultural Experiment Station and United States Department of Agriculture.)

THE TETON POTATO: A NEW VARIETY RESISTANT TO RING ROT[26]

Teton was first grown in Maine in 1934 as U.S.D.A. Seedling 47102, originating from a cross between Earlaine and U.S.D.A.

[25] This abstract by Reiner Bonde and E. S. Schultz was published with the same title in Phytopathology Vol. 37, No. 1, p. 3. 1947.

[26] This is an abstract of a paper by W. A. Riedl, F. J. Stevenson, and Reiner Bonde, having the same title and published in The American Potato Journal Vol. 23, No. 11, pages 379-389. 1946.

Seedling 45146. Teton has become infected with ring rot much less readily than the common commercial varieties and in it the disease has spread very slowly, in tests in Wyoming and Maine. Tests in these States indicate comparatively high yield rate and cooking quality. The technical description includes large spreading vines, white flowers, and well-shaped, smooth, light yellow tubers.

COMPARISON OF DIFFERENT ORGANIC AND COPPER FUNGICIDES AND SOME COMBINATIONS OF FUNGICIDES WITH DDT FOR THE CONTROL OF POTATO DISEASES AND INSECTS[27]

In one test in Maine in 1945, Bordeaux mixture controlled late blight, early blight, and flea beetles better than seven other spray fungicides except for a slight inferiority to Phygon with late blight and to Basic Copper Arsenate with flea beetles. With respect to yield rate, Bordeaux mixture was superior to Isothan Q15, Phygon, and Puratized, but was somewhat inferior to Cuprocide, Copper Compound A, Tri Basic Copper Sulphate, and Basic Copper Arsenate. In another test, Bordeaux mixture controlled late blight, early blight, and flea beetles better than six other spray fungicides except for Basic Copper Sulphate with late blight, Karbam Z and Karbam Z and soap with early blight, and Basic Copper Arsenate with flea beetles. Bordeaux mixture controlled aphids less than the other fungicides except for Basic Copper Arsenate. With respect to yield rate, Bordeaux mixture was superior to Fermate, somewhat superior to Dithane and to Karbam Z and soap, and somewhat inferior to Basic Copper Sulphate, Basic Copper Arsenate, and Karbam Z. The addition of DDT improved the control of flea beetles and aphids with each fungicide, improved the control of late blight with each fungicide except Fermate and Karbam Z, and improved the control of early blight with each fungicide except Basic Copper Arsenate and Karbam Z. The yield rate was increased with each fungicide by 16 to 32 per cent through the addition of DDT, and was much greater with Basic Copper Sulphate, Basic Copper Arsenate, and Dithane in combination with DDT than with Bordeaux mixture in combination with DDT.

[27] This is an abstract of a paper by Reiner Bonde and Everett G. Snyder, having the same title and published in The American Potato Journal Vol. 23, No. 12, pages 415-425. 1946.

RESISTANCE OF POTATO SEEDLING VARIETIES TO THE NATURAL SPREAD OF LEAFROLL[28]

Seedling varieties were grown in rows next to rows of leafroll Chippewas in a part of Maine where the disease spreads readily. Most of 10,708 seedlings, from 105 crosses, soon contracted the disease but some did not. The resistant seedlings at first were from crosses made by using somewhat resistant commercial varieties such as Earlaine, Houma, Imperia, Katahdin, and Kepplestone Kidney. Later crosses were made using the best looking resistant seedlings and gave a higher proportion of seedlings showing resistance. About two dozen characteristics, which are listed, are required in seedlings if they are to be suitable for growing, but these characteristics can be combined with leafroll resistance.

LEAFROLL NET NECROSIS AND STEM-END BROWNING OF POTATO TUBERS IN RELATION TO TEMPERATURE AND CERTAIN OTHER FACTORS[29]

Potato tubers can develop leafroll net necrosis in storage only when certain conditions prevail—the variety is susceptible to leafroll; the plants producing the tubers have become infected by leafroll during the season of production of the tubers; the variety is capable of developing net necrosis as a symptom of recent leafroll infection; the storage temperature lies within certain limits. Net necrosis develops to the greatest extent at about 45° to 50° F. and is absent or nearly so at 33° and 70° F. These suppressive temperatures become preventive for good if maintained for 60 days at the beginning of storage, storage here meaning the period starting with vine maturity if digging is postponed so that the first part of storage occurs in the soil. The development of net necrosis is greatly reduced by clipping off ⅛ inch of the stem end or by splitting the tubers at the beginning of storage, but is not affected by relative humidity. The larger the tubers, the greater the percentage of tubers that develops net necrosis. The percentage also varies with the field in which the crop is grown. Stem-end browning in Maine, attributable to a virus

[28] This is an abstract of a paper by Donald Folsom and F. J. Stevenson having the same title and published in The American Potato Journal Vol. 23, No. 7, pages 247-264. 1946.

[29] This is an abstract of a paper by Donald Folsom having the same title and published in Phytopathology Vol. 36, No. 12, pages 1016-1034. 1946.

rather than to bacteria or fungi, reacts to temperature and some other conditions much as does net necrosis, but the minimum, optimum, and maximum temperatures are respectively somewhat higher and the percentage of affected tubers is smaller as the tubers are larger.

SUSCEPTIBILITY OF GREEN MOUNTAIN AND IRISH COBBLER COMMERCIAL STRAINS TO STEM-END BROWNING[30]

Serological tests indicated either the presence of a virus in strains of Green Mountains susceptible to the disease but not in resistant ones or the presence of different strains of the same virus in the two types of Green Mountain potato. Neither caging nor the passage of years had any effect upon the amount of stem-end browning in a strain of potatoes, except that uncaged Minnesota stock increased in susceptibility to a slight extent the first year grown in Maine. Tuber and inarch grafting transmitted a factor favoring stem-end browning development to some extent, but mechanical inoculation of potato leaves and tubers did not. Inoculations of other kinds of plants produced no effects attributable to a stem-end browning virus and showed that the disease could occur in Green Mountain seedlings in the absence of Virus X (latent mosaic).

STUDIES OF THE CAUSE OF STEM-END BROWNING IN GREEN MOUNTAIN POTATOES[31]

Stem-end browning usually extends into the tuber flesh more than one-half inch. It develops most rapidly in the first 100 days of 50° F. storage, and under these conditions it was two to seven times as abundant in some commercial strains of potatoes than in others. Within a given strain, all tuber lines were equally predisposed to the disease. Serological tests indicated that the disease depended upon the presence of a virus, or upon the presence of a particular strain of a virus. Caging and shading had no effect,

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[30] This is an abstract of a paper by A. Frank Ross, having the same title and published in The American Potato Journal Vol. 23, No. 6, pages 219-234. 1946.

[31] This is an abstract of a paper by A. Frank Ross, having the same title and published in Phytopathology Vol. 36, No. 11, pages 925-936, 1946.

nor did the passage of years, upon the amount in a strain of potatoes, except that uncaged Minnesota stock increased in susceptibility the first year grown in Maine. Tuber and inarch grafting transmitted susceptibility to some extent, but mechanical inoculation of potato tubers and leaves did not. Leaf inoculations of other kinds of plants showed that stem-end browning could occur in the absence of Virus X (latent mosaic) and produced no effects attributable to a stem-end browning virus. Stem-end browning susceptibility had no effect upon susceptibility to leafroll and leafroll net necrosis.

RATE OF ABSORPTION AND TRANSLOCATION OF MINERAL NUTRIENTS BY POTATOES IN AROOSTOOK COUNTY, MAINE, AND THEIR RELATION TO FERTILIZER PRACTICES[32]

A study was made from 1938 to 1940 at Aroostook Farm, Presque Isle, Maine, to determine the rate of and total absorption of nitrogen, phosphoric acid, potash, calcium oxide, magnesia, and sulfur by different varieties of potatoes when these nutrients were supplied at varying rates under Aroostook County conditions. Data obtained in 1939 with the Green Mountain variety fertilized with an average of 2,500 pounds of 4-8-8 per acre are presented.

The Green Mountain variety of potato elaborated 50 per cent of its total dry weight during the 31-day period 51 to 81 days after planting.

During the first 50 days after planting the Green Mountain variety absorbed 8.1 per cent of the total major nutrients while producing only 3.2 per cent of the total growth. Of the total amount of the six major nutrients absorbed during the season, 71 per cent was absorbed during the 31-day period 51 to 81 days after planting.

[32] This is an abstract of a paper by Arthur Hawkins, having the same title and published in Journal of the American Society of Agronomy Vol. 38, No. 8, pages 667-681. 1946.

The absorption of nutrient elements occurs relatively more rapidly than the elaboration of dry matter during the early stages of growth. The reverse situation takes place during the latter part of the growing season.

The peak rate of absorption of nutrients was found to occur approximately 10 days prior to the peak rate of dry matter elaboration. The peak rate of absorption of nutrients occurred during the

interval 61 to 70 days after planting, or 30 to 40 days after emergence. During this period 27.1 per cent of the total nutrients taken up during the season were absorbed. In 1939, during this 10-day period of maximum absorption, an acre of potatoes absorbed the following approximate amounts of nutrients in pounds per acre per day: Nitrogen, 3.8; phosphoric acid, 0.6; potash, 6.4; calcium oxide, 1.6; magnesium oxide, 0.9; and sulfur, 0.3.

The highest contents of nutrients found in potato plants with tubers included of the Green Mountain variety fertilized with an average of 2,500 pounds of 4-8-8 under 1939 conditions were about 143 pounds of nitrogen (N), 26 pounds of phosphoric acid (P_2O_5), 232 pounds of potash (K_2O), 56 pounds of calcium oxide (CaO), 30 pounds of magnesia (MgO), and 11 pounds of sulfur (S) per acre. A larger crop such as produced under 1943 conditions absorbed larger quantities of these nutrients, particularly N and K_2O.

The proportion of the nutrients absorbed that were translocated into the tubers was approximately as follows: four-fifths of the P_2O_5, two-thirds of the nitrogen, six-tenths of the sulfur, one-half of the K_2O, four-tenths of the MgO, and about one-twentieth of the CaO.

The tubers in the 387-bushel crop under 1939 conditions contained 95 pounds of nitrogen, 20 pounds of P_2O_5, 117 pounds of K_2O, 3.2 pounds of CaO, 12 pounds of MgO, and 6 pounds of S.

The relation of the rate and amount of absorption and translocation of mineral nutrients by potatoes in Aroostook County, Maine, to fertilizer practices is discussed.

APPENDIX

TABLE 1

Effect of Different Amounts of Lime in Bordeaux on Yield, Early Blight Infection and Flea Beetle Injury in the Katahdin Variety. Tribasic Copper Sulfate and Unsprayed Control Included for Comparison

Formula	Yield rate per acre[1]				Foliage injury[2]			
					Early blight		Flea beetle	
	Without DDT		With DDT[3]		Without DDT	With DDT[3]	Without DDT	With DDT[3]
	Barrels	Bushels	Barrels	Bushels	Per cent	Per cent	Per cent	Per cent
10-20-100 High lime	142	392	172	476	39.5	5.1	24.0	.2
10-10-100 Normal lime	146	402	169	469	7.3	0.4	15.0	.2
10-5-100 Low lime	149	410	183	506	3.0	0.6	9.0	1.0
Tribasic copper sulfate	156	432	181	499	10.0	0.4	13.5	1.5
Unsprayed control	161	444	—	—	21.5	—	17.8	—

[1] Average of six replicated two-row plots each 25 feet in length for each treatment.
[2] Adapted from Horsfall, James G., in Fungicides and Their Action, Waltham, Mass. Chronica Botanica 1945. See pp. 38-41.
[3] DDT where added was at rate of two pounds of 50 per cent wettable powder per 100 gallons.
Significance at 5 per cent level 15.66 barrels or 43.06 bushels.
Significance at 1 per cent level 20.88 barrels or 57.42 bushels.

TABLE 2

Control of Aphids on Katahdin Potatoes Sprayed with Bordeaux Containing Different Amounts of Lime with and without DDT. Tribasic Copper Sulfate and Unsprayed Control Included for Comparison[1] [2]

Treatment	Dates of making observation			
	August 2	August 12	August 23	September 3
	Number aphids per plant[3]			
A. 10-20-100[4]	37	177	4278	4565
B. 10-20-2-100[4]	4	10	296	273
C. 10-10-100[4]	20	191	3453	6059
D. 10-10-2-100[4]	10	16	335	321
E. 10-5-100[4]	23	180	2758	8071
F. 10-5-2-100[4]	9	22	396	286
G. Tribasic copper sulfate (4 pounds 100 gallons)	75	202	3872	5782
H. Tribasic copper sulfate and DDT	7	20	337	286
Unsprayed control	62	235	2435	3095
	Per cent control			
A. vs. B.	89.2	94.4	93.1	94.0
C. vs. D.	50.0	91.6	90.3	94.7
E. vs. F.	60.0	87.8	85.7	96.5
G. vs. H.	90.7	90.1	91.3	95.1

[1] Using data secured from same plots as for Table 1.
[2] DDT where added was at rate of two pounds of 50 per cent wettable powder per 100 gallons.
[3] Calculated by counting the number of aphids from random sample of 90 leaflets taken from top, middle, and bottom parts of five plants from each of six replications for each treatment. These figures were multiplied by a factor to give average number of aphids per plant.
[4] Numbers in formula refer respectively to pounds copper sulfate, lime, DDT if used, and gallons of made-up spray mixture.

TABLE 3

Effect on Height of Katahdin Plants from Spraying with Bordeaux Mixture Made with Different Amounts of Lime with and without DDT. Tribasic Copper Sulfate and Untreated Control Included for Comparison[1]

Fungicide	Formula	Average height of plants[2]		Increase in height from DDT
		Without DDT	With DDT	
		Inches	Inches	Inches
Bordeaux high-lime content	10-20-100	16.7	18.5	1.8
Bordeaux medium-lime content	10-10-100	18.2	19.5	1.3
Bordeaux low-lime content	10- 5-100	19.2	20.2	1.0
Tribasic copper sulfate	4-100	19.2	19.4	0.2
Unsprayed control	—	19.7	—	—

[1] Using data secured from same plots as for Table 1.
[2] Average of 10 random plants from each of six replications for each treatment. Uninjured stalks of the plants were stretched upright and measurements made from the ground level to the tip of the stem. Plots with and without DDT for each fungicide were adjacent to each other.

TABLE 4

Effect of Different New Fungicides in Combinations with Benzene Hexachloride on the Control of Early Blight and Flea Beetle Injury and on General Foliage Symptoms with the Katahdin Variety
DDT Added to Two Materials for Comparison

Spray treatment No.	Spray material[1]	Formula[2]	Pounds metallic copper or zinc per 100 gallons	Foliage injury[3]		Condition of foliage[4]	
				Early blight	Flea beetle	Type of injury	Relative ranking
				Per cent	Per cent		
1	Genicop[5] (DDT + basic copper sulph)	3-1-100	1.20	2.5	1.2	Excellent, leaves green with slight rolling	1 best
2	Spraycop with benzene hexachloride (basic copper)	4-2-100	1.60	3.0	0.6	Severe rolling, chlorosis and discoloration	5th
3	Fungicide #629[6] with benzene hexachloride	2-2-100	0.0 + .68 Zn	17.0	0.5	Fair, less rolling than #1	4th
4	Fungicide #629 and #308 with benzene hexachloride	2-2-100	.32 + .34 Zn	15.0	1.0	Good	3rd
5	Fungicide #308[7] with benzene hexachloride	2-2-100	.664	8.5	1.0	Very good, slight rolling and discoloration	2nd nearly as #1
6	Bordeaux with DDT	8-4-2-100	2.00	4.4	2.3	Fair plants, dwarfed and tattered	6th
7	Unsprayed control			60.0	14.0	Nearly dead	7th

[1] Supplied by General Chemical Co., New York, N. Y.
[2] First and second figures refer to pounds fungicide, DDT or benzene hexachloride respectively per 100 gallons of spray material except for Bordeaux where first figure is pounds copper sulfate, second figure is pounds hydrated lime, and third figure is pounds 50 per cent wettable DDT powder per 100 gallons spray mixture.
[3] Calculations adapted from Horsfall, James G. Fungicides and Their Action. Waltham, Mass. Chronica Botanica 1945. pp. 38-41. 1947.
[4] Observations made August 28 and September 29, 1947.
[5] Contains 25% DDT and 40% copper in form of basic copper sulfate.
[6] An organic spray material containing 33.8 per cent zinc, 25.4 per cent sulfur, and 5 per cent nitrogen.
[7] An organic spray material as above but containing 32.3 per cent copper, 32 per cent sulfur, and 7 per cent nitrogen.

TABLE 5

The Effect on Yield of Spraying Katahdin Potatoes with Different Combinations of Fungicides with Benzene Hexachloride DDT Added to Two Materials for Comparison[1]

Spray treatment No.	Spray material[2]	Formula[3]	Yield per acre[4]	
			Barrels	Bushels
1	Genicop[5]	3-1-100	173	477
2	Spraycop with benzene hexachloride	4-2-100	168	463
3	Fungicide #629[6] with benzene hexachloride	2-2-100	170	469
4	Fungicide #629 and #308 with benzene hexachloride	2-2-100	183	505
5	Fungicide #308[7] with benzene hexachloride	2-2-100	182	502
6	Bordeaux with 50% wettable DDT powder	8-4-2-100	173	478
7	Unsprayed control	—	167	460

[1] Using data secured from same plots as for Table 4.
[2] Supplied by General Chemical Co., New York, N. Y.
[3] First and second figures refer to pounds fungicide, DDT or benzene hexachloride respectively per 100 gallons spray material except for Bordeaux where first figure is pounds copper sulfate, second figure is pounds hydrated lime, and third figure is pounds 50 per cent wettable DDT powder per 100 gallons spray mixture.
[4] Yields are averages of twelve one-row plots each 25 feet in length for each treatment.
[5] Contains 25 per cent DDT and 40 per cent copper in form of basic copper sulfate.
[6] An organic spray material containing 33.8 per cent zinc, 25.3 per cent sulfur, and 5 per cent nitrogen.
[7] Organic spray material as above but containing 32.3 per cent copper, 32 per cent sulfur, and 7 per cent nitrogen.

TABLE 6

Reduction in Number of Aphids on Katahdin Potatoes Sprayed with Different Fungicides and Combinations with DDT or Benzene Hexachloride DDT Added to Two Materials for Comparison[1]

Spray treatment No.	Spray materials[2]	Formula[3]	Aphids per plant[4]			
			August 1	August 12	August 23	September 3
1	Genicop[5]	3-1-100	4	27	497	310
2	Spraycop and benzene hexachloride[6]	4-2-100	5	30	464	238
3	Fungicide #629[7] with benzene hexachloride	2-2-100	5	32	624	404
4	Fungicide #629 and #308 with benzene hexachloride	2-2-100	20	70	524	455
5	Fungicide #308[8] with benzene hexachloride	2-2-100	7	70	400	196
6	Bordeaux with 50% wettable DDT powder	8-4 2-100	12	65	1231	1876
7	Unsprayed control		55	227	2164	2347

[1] Using data secured from same plots as for Tables 4 and 5.
[2] Fungicides supplied by General Chemical Co., New York, N. Y.
[3] First and second figures refer to pounds fungicide, DDT or benzene hexachloride respectively per 100 gallons spray material except for Bordeaux where first figure is pounds copper sulfate, second figure is pounds hydrated lime, and third figure is pounds 50 per cent wettable DDT powder per 100 gallons spray mixture.
[4] Calculated by counting the number of aphids from random sample of 90 leaflets taken from top, middle, and bottom parts of five plants from each of six replications for each treatment. These figures were multiplied by a factor to give average number of aphids per plant.
[5] Contains 25 per cent DDT and 40 per cent copper in form of basic copper sulfate.
[6] Contains basic copper sulfate containing 40 per cent copper and wettable benzene hexachloride carrying 5 per cent gamma isomer.
[7] An organic spray material containing 33.8 per cent zinc, 25.3 per cent sulfur, and 5 per cent nitrogen.
[8] An organic spray material containing 32.3 per cent copper, 32 per cent sulfur, and 7 per cent nitrogen.

TABLE 7

Effect of Various Treatments of Table 6 on Aphid Infestation[1]

Spray treatment No.	Treatments compared with unsprayed control	Per cent control[2]			
		August 1	August 12	August 23	September 3
		Per cent	Per cent	Per cent	Per cent
1	Neutral copper and DDT	93	89	78	87
2	Neutral copper and benzene hexachloride	91	87	79	90
3	Fungicide #629 with benzene hexachloride	91	86	72	83
4	Fungicide #629 and #308 with benzene hexachloride	64	70	76	81
5	Fungicide #308 with benzene hexachloride	88	70	82	92
6	Bordeaux and DDT, 50% wettable powder	79	72	44	21

[1] From same plots as recorded in Tables 4, 5, and 6.
[2] Calculated in terms of number of aphids per plant of treatments compared with number of aphids on unsprayed control plants.

TABLE 8

Effect on Yield and Flea Beetle and Aphid Injury from Spraying Katahdin Potatoe with Different Fungicides and Combinations of These Fungicides with DDT or with DDD

Spray material	Amount per 100 gallons spray material[1]	Yield per acre[2]		Flea beetle injury[3]	Aphids per plant September 16	Control
		Barrels	Bushels	Per cent	Number	Per cent
Powdered Dithane and DDT 50% wettable powder[4]	2½-2-100	210	577	2.5	377	84.2
Powdered Dithane and DDD 50% wettable powder[5]	2½-2-100	207	569	6.9	4241	Minus reduction 78.2
Zinc Copper Chromate #169A[6]	5½-100	162	446	31.0	7339	Minus reduction 209.0
Zinc Copper Chromate #169A[6] and DDT, 50% wettable powder	5½-2-100	205	564	1.5	245	89.7
C.O.C.S. #7 (⅔ Copper Oxychloride and ⅓ Basic Copper Sulfate)[7]	4-100	170	468	15.0	6034	Minus reduction 154.
C.O.C.S. #7 and DDT 50% wettable powder[7]	4-2-100	206	567	1.1	129	94.6
Basic Copper Sulfate and DDT 50% wettable powder	4-2-100	207	569	1.0	236	90.1
Bordeaux and DDT 50% wettable powder	8-6-2-100	173	484	1.3	125	94.8
Bordeaux control	8-6-100	151	415	6.0	13627	Minus reduction 473.7
Unsprayed control	—	173	476	60.5	2375	

[1] DDT or DDD if used was at rate of 2 pounds 50% wettable powder per 100 gallons of spray mixture.
[2] Yields are averages of 12 replicated one-row plots each 25 feet in length.
[3] Calculations adapted from Horsfall, James G. Fungicides and Their Action. Waltham, Mas Chronica Botanica, 1945, pp. 38-41. 1947.
[4] Supplied by Rohm & Haas Company, Philadelphia, Pa., containing Dithane (disodium ethyle bisdithiocarbamate) and DDT (dichloro-diphenyl-trichloroethane).
[5] Supplied by Rohm & Haas Company, Philadelphia, Pa., containing Dithane and DDD, a Rotha D3 (dichloro-diphenyl-dichloroethane).
[6] Supplied by Carbide and Carbon Chemicals Corp., Biological Research Division, Yonkers, N.
[7] Supplied by the Harshaw Chemical Co., Cleveland, O.

Significance at 1 per cent level is 7.85 barrels or 21.6 bushels.
Significance at 5 per cent level is 5.96 barrels or 16.4 bushels.

TABLE 9

Effect on Aphid Population from Spraying Katahdin Potatoes with Different Fungicides and Combinations of Fungicides with DDT or DDD. Bordeaux Mixture with and without DDT and Unsprayed Controls Included for Comparison[1]

Spray material	Amount per 100 gallons spray material[2]	Aphid-date of making observations			
		August 5	August 14	August 31	September 16
		Number of aphids per plant[3]			
1. Powdered Dithane and DDT[4]	2½-2-100	39	83	554	377
2. Powdered Dithane and DDD[5]	2½-2-100	464	656	2807	4241
3. Zinc Copper Chromate #169A[6]				7745	7339
4. Zinc Copper Chromate #169A and DDT	5½-2-100	23	32	755	245
5. C.O.C.S. #7 (⅔ Copper Oxychloride and ⅓ Basic Copper Sulfate)[7]	4-100	356	1273	7852	6034
6. C.O.C.S. #7 and DDT	4-2-100	5	88	83	129
7. Basic Copper Sulfate and DDT	4-2-100	85	83	462	236
8. Bordeaux and DDT	8-6-2-100	104	118	353	125
9. Bordeaux control	8-6-100	767	1381	7623	13627
10. Unsprayed control	—	765	1395	2964	2375
		Percentage control—aphids			
1 vs. 10 (Unsprayed control)		95	94	81	84.2
2 vs. 10		40	53	5	Minus reduction 178.3
3 vs. 10		41	Minus reduction 101	Minus reduction 261	Minus reduction 309
4 vs. 10		97	98	75	90
5 vs. 10		54	9	Minus reduction 2651	Minus reduction 254
6 vs. 10		99	94	97	95
7 vs. 10		89	94	84	90
8 vs. 10		87	92	88	95
9 vs. 10		Minus reduction 100.2	1	Minus reduction 257	Minus reduction 574

[1] From same plots as recorded in Table 8.
[2] DDT or DDD if used was at rate of 2 pounds 50% wettable powder per 100 gallons of spray mixture.
[3] Calculated by counting number of aphids from random samples of 90 leaflets taken from top, middle, and bottom of 5 plants from six replications for each treatment. These figures were multiplied by a factor to give the average number of aphids per plant.
[4] Supplied by Rohm and Haas Co., Philadelphia, Pa., containing Dithane (disodium ethylene bisdithiocarbamate) and DDT (Dichloro-diphenyl-trichloroethane).
[5] Supplied by Rohm and Haas Co., Philadelphia, Pa., containing Dithane and DDD (Rothane D3, dichloro-diphenyl-dichlorethane).
[6] Supplied by Carbide and Carbon Chemical Corp., Biological Research Division, Yonkers, N. Y.
[7] Supplied by the Harshaw Chemical Co., Cleveland, O.

TABLE 10

The Effect on Yield of Spraying Katahdin Potatoes with Phygon, Dithane, and Bordeaux and with Combinations of These Fungicides with DDT—1946

Fungicide	Formula concentration per 100 gallons	Yield per acre[1]				Foliage injury[2]			
		Without DDT		With DDT		Early blight		Flea beetle	
						Without DDT	With DDT	Without DDT	With DDT
		Barrels	Bushels	Barrels	Bushels	Per cent	Per cent	Per cent	Per cent
Bordeaux control	8-4-100	149	411	166	458	2.0	3.5	18.0	0.5
Phygon (2-3 dichloro-naphthoquinone 1-4)[3]	1-100	146	403	177	490	7.3	3.4	24.0	1.3
Dithane (disodium ethylene bisdithiocarbamate)[4]	2 qts. with 1 lb. $ZnSO_4$ and ½ lb. lime	159	438	194	536	0.9	0.4	24.0	0.5
Unsprayed control	None except for potato beetle	152	420			15.1		21.0	

[1] Based on 12 replicated 1-row plots each 25 feet in length for each treatment.
[2] Calculations adapted from Horsfall, James G. Fungicides and Their Action. Waltham, Mass. Chronica Botanica 1945. pp. 38-41. 1947.
[3] Supplied by Naugatuck Chemical Division of U. S. Rubber Company, Naugatuck, Conn.
[4] Supplied by Rohm and Haas Co., Philadelphia, Pa.

Significance at 1 per cent level is 13.4 barrels or 37.1 bushels.
Significance at 5 per cent level is 17.9 barrels or 49.4 bushels.

TABLE 11

The Effect on the Aphid Population from Spraying Katahdins with Bordeaux, Phygon, and Dithane and with Combinations of These Fungicides with DDT[1]

Fungicide and Insecticide	Formula or concentration per 100 gallons	Aphid-counts made on August 2	August 12	September 4
		Number aphids per plant[2]		
1. Bordeaux control	8-4-100	22	173	3504
2. Bordeaux and DDT	8-4-2-100	4	39	162
3. Phygon (2-3 dichloro-naphthoquinone 1-4)[3]	1-100	22	120	2107
4. Phygon and DDT	1-2-100	3	15	316
5. Dithane (disodium ethylene bisdithio-carbamate)[4]	2 qts. with 1 lb. $ZnSO_4$ and ½ lb. lime	23	233	4387
6. Dithane and DDT	2 qts. with 1 lb. $ZnSO_4$, ½ lb. lime and 2 lbs. DDT	7	18	316
7. Unsprayed control		49	223	1236
		Percentage control of aphids comparing fungicides with and without DDT		
DDT added to Bordeaux 1. vs. 2.		82.0	77.5	95.4
DDT added to Phygon 3. vs. 4.		86.4	87.5	85.1
DDT added to Dithane 5. vs. 6.		70.0	92.3	92.8
		Percentage control of aphids comparing fungicides with DDT with unsprayed controls		
Bordeaux and DDT with control 2. vs. 7.		91.8	83.0	96.9
Phygon and DDT with control 4. vs. 7.		93.9	93.3	74.4
Dithane and DDT with control 6. vs. 7.		86.0	91.9	74.4

[1] From same plots as recorded in Table 10.
[2] Calculated by counting the number of aphids from random samples of 90 leaflets taken from top, middle, and bottom parts of five plants from each of six replications for each treatment. These figures were multiplied by a factor to give the approximate number of aphids per plant.
[3] Supplied by Naugatuck Chemical Division of U. S. Rubber Co., Naugatuck, Conn.
[4] Supplied by Rohm and Haas Co., Philadelphia, Pa.

TABLE 12

Yield Comparison and Control of Early Blight and Flea Beetle Injury with Different Dust Fungicides and Combinations with DDT

Fungicide[3]	Per cent metallic copper content of formula	Yield per acre[1]				Foliage injury[2]			
		Without DDT		With DDT		Early blight		Flea beetle	
						Without DDT	With DDT	Without DDT	With DDT
		Bbls.	Bu.	Bbls.	Bu.	Per cent	Per cent	Per cent	Per cent
Cuprocide talc dust	4.1	174	481	192	529	4.5	1.2	6.1	3.3
Basic copper sulfate-talc dust	5.0	163	450	177	489	9.0	4.2	6.4	4.4
Basic copper sulfate-talc dust	7.0	159	438	182	502	4.2	5.0	20.7	3.3
Monohydrated copper sulfate-lime dust	7.0	159	438	142[4]	391[4]	5.1	6.8	20.7	5.4
Dithane dust	—	—	—	191	527	—	10.3	—	3.4
Unsprayed check	None	162	447	—	—	55.0	—	31.0	—

[1] Average of four replicated two-row plots each 25 feet in length for each treatment.
[2] Adapted from Horsfall, James G. in Fungicides and Their Action, Waltham, Mass. Chronica Botanica 1945. See pp. 38-41.
[3] Six applications of fungicides were applied with a hand duster at the rate of 35 to 45 pounds per acre per application.
[4] Plots of these treatments were injured by flooding with water which resulted in decay in some tubers and possibly a decrease in the yield rate.

Significance at 5 per cent level is 20.2 barrels or 55.5 bushels.

TABLE 13

Reduction in Number of Aphids on Katahdin Potato Plants Dusted with Different Dust Fungicides and Combinations of These Fungicides with DDT[1]

Fungicide and insecticide[2]	Per cent in formula		Dates aphids counted[3]		
	Metallic copper	DDT	August 13	August 23	September 5
			Number aphids per plant		
A Cuprocide-talc dust	4.1	0	26	1805	1230
B Cuprocide-talc dust and DDT	4.1	3	3	445	171
C Basic copper sulfate-talc dust	5.0	0	15	1013	1319
D Basic copper sulfate-talc dust and DDT	5.0	3	5	401	158
E Basic copper sulfate-talc dust	7.0	0	26	2482	1777
F Basic copper sulfate-talc dust and DDT	7.0	3	6	393	210
G Monohydrated copper-lime dust	7.0	0	22	2971	3507
H Monohydrated copper-lime dust and DDT	7.0	3	20	2040	1376
I Untreated control	—	—	56	3016	1326
			Percentage control aphids per plant		
A vs. B	—	—	89	75	86
C vs. D	—	—	67	60	88
E vs. F	—	—	77	84	92
G vs. H	—	—	9	31	61

[1] From same plots as recorded in Table 12.
[2] Plots received six applications of fungicide during the season, applied with a hand duster and at the rate of 35 to 45 pounds per acre per application.
[3] Calculated by counting the number of aphids from random samples of 90 leaflets taken from top, middle, and bottom parts of five plants from each of six replications for each treatment. These figures were multiplied by a factor to give the approximate number per plant.

TABLE 14

The Effect of a Sticker in the Spray Material on the Yield and Control of Early Blight and Flea Beetles

Treatment	Concentration per 100 gallons	Yield per acre[1]		Foliage injury[2]		Aphid control[3]	
				Early blight	Flea beetle		
		Barrels	Bushels			Number per plant[4]	Per cent control
Control, no treatment	—	152	420	15.1	21.0	1236	—
Latex (Polyethylene polysulfide 40% by weight active agent)[5]	2 lbs.	163	452	7.6	42.0	1169	6.0
DDT and Latex	2 lbs. DDT 50% wettable powder and 1 lb. latex	187	516	9.1	0.9	182	90.0
Tribasic copper sulfate and DDT	4 lbs. tribasic copper sulfate and 2 lbs. DDT	173	478	0.8	1.4	247	85.0
Tribasic copper sulfate, DDT and latex	4 lbs. tribasic copper sulfate, 2 lbs. DDT and 1 lb. latex	172	476	4.1	1.0	1236	80.0

1 Average of six replicated two-row plots each 25 feet in length.
2 Adapted from Horsfall, James G. Fungicides and Their Action. Waltham, Mass. Chronica Botanica 19:5. See pages 38-41.
3 In comparison with unsprayed control plots, observations made September 4, 1946.
4 Calculated by counting the number of aphids from random samples of 90 leaflets taken from top, middle, and bottom parts of five plants from each of six replications for each treatment. These figures were multiplied by a factor to give the approximate number per plant.
5 Synthetic latex supplied by B. F. Goodrich Chemical Co., Cleveland, O.

TABLE 15

Effect of a Sticker in the Spray Material on the Number of Aphids Infecting Katahdin Potato Plants[1]

Spray treatment No.	Spray material	Concentration per 100 gallons	Aphids—dates counted August 2	August 12	September 4
			Number per plant[2]		
1	Latex (Polyethylene polysulfide 40% by weight active)[3]	2 lbs.	123	127	1169
2	DDT and latex	2 lbs. DDT and 1 lb. latex	5	11	120
3	Tribasic copper sulfate and DDT	4 lbs. tribasic copper sulfate and 2 lbs. DDT	6	26	182
4	Tribasic copper sulfate DDT and latex	4 lbs. tribasic copper sulfate, 2 lbs. DDT, and 1 lb. latex	7	14	247
5	Control, no treatment	None, except for Colorado potato beetle	49	223	1236
			Percentage control in number		
	Latex compared with control, 1 vs. 5	—	Minus reduction 251	43	6
	DDT and latex compared with control, 2 vs. 5	—	90	95	90
	Tribasic copper sulfate and DDT compared with control 3 vs. 5	—	88	89	85
	Tribasic copper sulfate, DDT and latex compared with control, 4 vs. 5	—	86	94	80

[1] From same plots as recorded in Table 14.
[2] Calculated by counting the number of aphids from random samples of 90 leaflets taken from top, middle, and bottom parts of five plants from each of six replications for each treatment. These figures were multiplied by a factor to give the approximate number per plant.
[3] Synthetic latex supplied by B. F. Goodrich Chemical Co., Cleveland, O.

TABLE 16

Yields Comparing Different Amounts of Tribasic Copper Sulfate in Spray Formula with and without DDT[1]

Formula	Yield per acre[2] Without DDT Barrels	Without DDT Bushels	With DDT Barrels	With DDT Bushels	Increases from adding DDT Barrels	Bushels	Per cent
1-100	165	454	186	512	21	58	12.7
4-100	155	427	188	517	33	90	21.3
DDT control 0-2-100		–	185	509	2	6	1.1
Unsprayed control	183	503	—	—			

[1] Six applications made during the season with a horse-drawn spray rig applying 90 gallons per acre per application.
[2] Mean of eight replicated two-row plots each 50 feet in length.
Significance at 1 per cent level is 26.4 barrels or 72.6 bushels.
Significance at 5 per cent level is 18.6 barrels or 51.0 bushels.

TABLE 17

Yields Comparing Katahdin Potatoes Sprayed with Yellow Copper Oxide and Bordeaux with and without Insecticides[1]

Fungicide	Formula	Yield rate per acre[2]		Increase from applying DDT		
		Barrels	Bushels	Barrels	Bushels	Per cent
Yellow copper oxide	1½-100	154	424			
Yellow copper oxide and oil emulsion containing 25% DDT	1½-1 qt.-100	178	490	24	66	15.6
Bordeaux	10-5-100	150	413			
Bordeaux and 5% DDT oil emulsion	10-5-3 gals.-100[3]	170	470	20	57	13.3

[1] Six applications made during the season with an eight-row tractor-drawn spray rig applying approximately 140 gallons per acre per application.
[2] Yields based on means of 10 replicated two-row plots each 156 feet long.
[3] The oil contained five per cent DDT.
Significance at 1 per cent level is 15.2 barrels or 42.0 bushels per acre.
Significance at 5 per cent level is 20.5 barrels or 56.6 bushels per acre.

TABLE 18

The Effect on Yield Rate of Spraying or Dusting Katahdin Potatoes with Different Fungicides and with Combination of These Fungicides with DDT[1]

Fungicide	Formula or percentage copper	Yield rate per acre[2]				Increase from applying DDT		
		Without DDT		With DDT[3]				
		Barrels	Bushels	Barrels	Bushels	Barrels	Bushels	Per cent
Bordeaux	8-4-100	149	410	—	—	—	—	—
Basic Copper Sulfate Dust	5% Copper	145	399	165	453	20	56	13.8
Yellow Copper Oxide Dust	4.1% Copper	145	399	161	442	16	45	11.0
Unsprayed control	None except for control of potato beetles	158	435	—	—	—	—	—

[1] Six applications made during the season with an eight-row tractor-drawn duster which applied approximately 35 pounds of dust per acre per application.
[2] Yields based on means of 10 replicated two-row plots each 18 feet long.
[3] Dusts contained 3 per cent DDT.
Significance at 1 per cent level is 23.09 barrels or 63.45 bushels at 5 per cent level.
Significance at 5 per cent level is 17.26 or 47.46 bushels at 5 per cent level.

TABLE 19

Ring Rot Resulting from Treating Contaminated Potato Seed Pieces with Different Copper-Containing Materials

Material[1]	Concentration of disinfectant	Time exposed to disinfectant	Ring rot developing from inoculated treated seed pieces	Ring rot in control
			Per cent[2]	Per cent[2]
Yellow copper oxide	2 pounds in 100 gallons	10 minutes	66	81
"	4 pounds in 100 gallons	"	55	
"	8 pounds in 100 gallons	"	43	
"	2 pounds in 100 gallons	60 minutes	40	82
"	4 pounds in 100 gallons	"	21	
"	8 pounds in 100 gallons	"	19	
Basic copper sulfate	5 pounds in 100 gallons	10 minutes	74	81
"	10 pounds in 100 gallons	"	56	
"	20 pounds in 100 gallons	"	53	
"	5 pounds in 100 gallons	60 minutes	24	83
"	10 pounds in 100 gallons	"	25	
"	20 pounds in 100 gallons	"	12	
Tribasic copper sulfate	5 pounds in 100 gallons	10 minutes	71	82
"	10 pounds in 100 gallons	"	63	
"	20 pounds in 100 gallons	"	50	
"	5 pounds in 100 gallons	60 minutes	54	83
"	10 pounds in 100 gallons	"	29	
"	20 pounds in 100 gallons	"	23	
Corrosive sublimate	8 ounces in 30 gallons	10 minutes	1	81

[1] Freshly cut potato seed pieces were contaminated by being dipped in a heavy suspension of the ring rot organism and planted immediately in the field.
[2] Based on disease reading from 100 inoculated seed pieces planted in the field.

TABLE 20

Ring Rot Resulting from Treating Contaminated Potato Seed Pieces with Different Disinfectants

Chemical[1]	Concentration of active ingredient	Concentration of treating solution[2]	Ring rot developing from inoculated treated seed pieces
	Per cent		Per cent[3]
Q-15	20	1-5000	93
Q-32	20	1-5000	99
Q-35	20	1-5000	97
Q-45	20	1-5000	94
Q-58	65	1-5000	96
Q-69	20	1-5000	98
ERL-31[4]	20	1-5000	99
ERL-38[4]	20	1-5000	100
DL-1	75	1-5000	100
N-5-E	6	1-5000	84
#806	10	1-5000	83
Sodium hypochloride	5.25	2 gallons in 100 gallons	90
Formaldehyde	40	1 pint in 15 gallons	21
Corrosive sublimate	—	4 ounces in 30 gallons	2
Untreated control	—	—	99

[1] Supplied by Onyx Oil and Chemical Co., Jersey City, N. J.
[2] Freshly cut potato seed pieces were contaminated by being dipped in a heavy suspension of the ring-rot organism and treated for 10-minute periods in the different solutions.
[3] Based on disease reading from 100 inoculated seed pieces planted in the field.
[4] Supplied by Eastern Regional Research Laboratory, Philadelphia, Pa.

TABLE 21

Ring Rot from Treating Contaminated Potato Seed Pieces with Trioxo Concentrate Powder[1]

Lot No.[2]	Length of exposure	Plants infected with ring rot from treated seed pieces[3]
		Per cent
1	36 hours	88
2	"	96
3	"	96
4	"	96
Control	—	98
5	60 hours	82
6	"	94
7	"	96
8	"	96
Control	—	96

[1] Trioxo Concentrate Powder supplied by Cuprinol Inc., Boston, Mass.
[2] Each lot contained 50 freshly cut seed pieces inoculated by being dipped in a water suspension of the bacteria.
[3] Based on symptoms in plants just prior to first killing frost of the season.

TABLE 22

Ring Rot Resistant Seedlings in Different Progenies Inoculated in the Field in 1946. Ring Rot in Controls and Parents of Progenies Included for Comparison[1]

Variety or cross	U.S.D.A. pedigree	Seedlings tested	Controls and parent lot tested	Resistant seedlings or lots[2]	
				No.	Per cent
Katahdin Controls			100	0	0.0
Frie (47101)[3]			5	5	100.0
Teton (47102)			5	5	100.0
Mohawk			5	0	0.0
Green Mountain			5	0	0.0
46952			5	5	100.0
B61-3			5	0	0.0
B76-43			5	0	0.0
B83-9			5	0	0.0
Green Mountain x Teton	B 637	22		13	59.1
Katahdin x Teton	B 614	86		39	45.3
Mohawk x Teton	B 615	40		18	45.0
Mohawk x 46952	B 616	100		23	23.0
B 61-3 x 46952	B 613	9		3	33.3
B 76-43 x 46952	B 639	29		2	6.9
B 83-9 x 46952	B 608	133		50	37.6
B 83-9 x Teton	B 607	200		126	63.0
528-194 x Teton	B 604	30		11	36.6
Teton x 46952	B 638	22		12	54.5
Teton selfed	B 1123	105		89	81.6

[1] Five seed pieces of each seedling inoculated by being dipped in a heavy suspension of the bacteria and planted immediately in the field.
[2] Showed no ring rot symptoms in foliage or in tubers at time of harvest.
[3] Erie was not used in making the progenies here given but was included because of having been selected from the same cross as Teton.
NOTE: Seedling 528-194 also used as a parent in the 1946 studies was not tested for resistance to ring rot. This should be done in 1947.

TABLE 23

Percentage Ring Rot in the Same Seed Stocks for Three Successive Years

Ring rot in seed stocks[1]		
1944	1945	1946
Per cent	Per cent	Per cent
0 Healthy control	Trace	Trace
1	3.0	12.1
2	4.4	16.0
3	5.1	17.1
4	6.0	23.0
5	10.0	45.5
10	15.0	73.0

[1] Based on examination of approximately 1000 plants grown from each seed stock each season.

TABLE 24

Leafroll Resistance Study—Aroostook Farm, Presque Isle, Maine—1946

1944 Introductions

Pedigree	Parentage	Replanted in 1946	No. surviving 3 yrs. inoculation with L.R.	Saved for use as parents in further breeding work	Original No. of seedlings in cross	Per cent surviving 3 years' test
B 511	96-56 x Triumf	17	0	0	133	0
B 512	96-28 x Triumf	29	0	0	206	0
B 517	792-76 x 1241-91	33	0	0	284	0
B 518	792-88 x 1241-91	15	0	0	164	0
B 522	792-94 x 1241-91	55	1	1[1]	370	0.3
B 1113	Triumf selfed	274	11	4[2]	527	0.8

1945 Introductions

Pedigree	Parentage	Replanted in 1946		Saved for retesting in 1947	Original No. seedlings in cross	Per cent surviving 2 years' test
B 572	Katahdin x 247-30	183		5	683	0.7
B 573	Katahdin x 247-48	85		0	510	0
B 575	Mohawk x 247-48	86		1	558	0.2
B 577	Sequoia x 247-48	194		5	813	0.6
B 578	Sebago x 247-48	79		1	701	0.1
B 580	B24-76 x B61-3	97		1	400	0.3
B 582	247-24 x B24-58	122		28	302	9.3
B 583	B24-78 x 247-24	105		26	257	10.1
B 584	247-30 x 247-42	125		14	364	3.9
B 585	247-3 x 46952	50		2	166	1.2
B 586	528-194 x B24-58	58		3	199	1.5
B 672	627-103 x B24-238	41		1	174	0.6
B 673	B24-58 x 247-24	319		87	629	13.8
B 1122	247-24 selfed	116		16	347	4.6
B 1128	247-30 selfed	279		38	704	5.4
B 1129	247-48 selfed	159		4	830	0.5

[1] B 522-33—seedling saved for use as a parent.
[2] B 1113-254, B 1113-369, B 1113-393, B 1113-398 seedlings saved for use as parents.

1946 Introductions

Pedigree	Parentage	Planted in 1946	Saved for retesting in 1947	Per cent surviving 1 year's test
B 70 — 5	B127 x 96-56	5 hills	0	0
B294	Houma x 96-56	97	6	6.3
B301	Houma x Katahdin	94	6	6.4
B313	Sequoia x 96-56	100	0	0
B732	Teton x 247-24	83	1	1.2
B733	Green Mountain x 24-76	661	14	2.1
B734	Green Mountain x 247-44	523	9	1.7
B748	White Rose x B 24-58	662	42	6.3
B756	B24-238 x 96-56	516	27	5.2
B774	750-10 x Katahdin	127	3	2.4
B775	792-32 x B 24-58	107	10	9.3
B777	792-88 x Teton	412	1	0.2
B784	1276-48 x B 24-58	271	65	24.0
B785	1276-48 x 247-44	452	43	9.5
B787	1276-185 x Katahdin	146	8	5.5
B790	1276-185 x 247-44	262	20	7.6
B796	Houma x Katahdin	399	32	8.0
B798	247-42 x 247-44	342	17	5.0
B799	750-10 x 46952	329	79	24.0
B800	46952 x 247-44	247	7	2.8
B808	Triumf x Katahdin	170	12	7.1
B809	Triumf x 247-48	205	36	17.6
B810	Houma x Shamrock	298	49	16.4
B817	Houma x Triumf	611	115	18.4
B819	Houma x 247-48	600	60	10.0
B820	Houma x 336-144	402	8	2.0
B1135	247-24 selfed	289	2	0.7
B1136	247-42 selfed	372	21	5.6
B1137	247-48 selfed	264	1	0.4
B1138	Katahdin selfed	226	0	0

1946 Introductions (continued)

Pedigree	Parentage	Planted in 1946	Saved for retesting in 1947
	Varieties originally selected for field resistance to leafroll[3]		
X247-24	Kepplestone Kidney x Earlaine	5 hills	0
X247-30	Kepplestone Kidney x Earlaine	5 hills	0
X247-48	Kepplestone Kidney x Earlaine	5 hills	0
X750-10	Imperia x Katahdin	5 hills	0
X1276-18	Houma x Katahdin	5 hills	0
X1276-185	Houma x Katahdin	5 hills	0
B24-9	Imperia x Earlaine	4 hills	4 hills
B24-58	Imperia x Earlaine	5 hills	0
B24-76	Imperia x Earlaine	5 hills	0
B24-78	Imperia x Earlaine	5 hills	1 hill
B24-91	Imperia x Earlaine	5 hills	1 hill
B24-156	Imperia x Earlaine	5 hills	0
B24-190	Imperia x Earlaine	5 hills	1 hill
B24-238	Imperia x Earlaine	5 hills	5 hills
BX24-1147-7	Imperia x Earlaine	5 hills	0
BX24-1147-A7	Imperia x Earlaine	5 hills	0
BX24-1147A-16	Imperia x Earlaine	5 hills	0
BX24-1147A-19	Imperia x Earlaine	5 hills	0
BX28-184	Sebago x Earlaine	5 hills	0
CHB-69+ — 38 ?		5 hills	0
CHB-69+ — 52 ?		5 hills	0

[3] Though mostly susceptible to aphid inoculation with leafroll, their use as parents has given many seedlings resistant to aphid inoculation. (See Table 26.)

TABLE 25

Reactions of Progenies of Different Crosses to Leafroll Infection, Resulting from Artificial Inoculations with Viruliferous Aphids in 1944
Those which did not get leafroll were grown in 1945 and 1946[1]

Pedigree number	Parentage	Seedling in progeny tested	Leafroll symptoms: Current season 1944	Leafroll symptoms: Second season 1945[2]	Seedlings free of leafroll: 1945		Seedlings free of leafroll: 1946	
		No.	No.	No.	No.	Per cent	No.	Per cent
B 507	President x Katahdin	233	194	38	1	0.4	0	0.0
B 511	96-56 x Triumf	110	86	24	10	9.1	0	0.0
B 512	96-28 x Triumf	193	143	38	12	6.2	0	0.0
B 517	792-76 x 1241-91	271	206	48	17	6.3	0	0.0
B 518	792-88 x 1241-91	154	116	34	4	2.6	0	0.0
B 522	792-94 x 1241-91	352	224	89	39	11.1	3[3]	0.9
B1113	Triumf selfed	471	60	193	218	46.3	50[4]	10.6

[1] Progenies inoculated in 1944 and 5-hill lots from those that were not infested were replanted in 1945 and 1946.
[2] Current seasonal symptoms not present but leafroll infection apparent when seed tubers from inoculated plants were grown in 1945.
[3] Seedling B 522-33 saved for possible use as parent for making crosses in the future.
[4] Seedlings B 1113-254, B 1113-369, B 1113-393, and B 1113-398 saved for possible use as parents for making crosses in the future.

TABLE 26

Reaction of Progenies of Different Crosses to Leafroll Infection Resulting from Artificial Inoculations with Viruliferous Aphids in 1945 and Reinoculated in 1946[1]

Pedigree No.	Parentage	Original No. in progenies tested 1945	Replanted 1946[2]		Total surviving 1st inoculation 1945		Surviving 2nd inoculation 1946 and saved	
			No.	Per cent	No.	Per cent	No.	Per cent
B 572	Katahdin x 247-30	683	182	26.6	45	6.6	5	0.7
B 573	Katahdin x 247-48	510	84	16 5	7	1.4	0	0.0
B 575	Mohawk x 247-48	558	86	15.4	6	1.7	1	0.2
B 577	Sequoia x 247-48	813	191	23.5	28	3.4	5	0.6
B 578	Sebago x 247-48	701	77	9.8	4	0.6	1	0.1
B 580	B24-76 x B61-3	400	45	11.3	9	2.3	1	.2
B 582	247-24 x B24-58	302	122	40.4	76	25 2	28	9.3
B 583	B24-78 x 247-24	257	104	40.5	52	20.2	26	10.1
B 584	247-30 x 247-42	364	124	34.1	56	15.4	14	3.8
B 585	247-3 x 46952	166	50	30.1	20	12.0	2	1.2
B 586	528-194 x B24-58	199	58	29 1	19	9.5	3	1.5
B 672	627-103 x B24-238	174	41	23.6	10	5.7	1	.6
B 673	B24-58 x 247-24	629	317	50.4	166	26.4	87	13.8
B1122	247-24 selfed	347	114	32.8	40	11.5	16	4.6
B1128	247-30 selfed	704	277	39.4	97	13.8	38	5.4
B1129	247-48 selfed	830	156	18.8	15	1.8	4	.5

[1] Progenies inoculated 1945 and 5-hill lots of those that escaped infection planted in 1946.
[2] Some infected plants did not show current seasonal symptoms in 1945 and were planted in 1946.

TABLE 27

Difference in Breeding Value of Seedlings That Are Field-Resistant to Leafroll

As introduced in 1945		Observations in 1946	
Cross	Parents	Seedlings	Per cent leafroll
B568	Green Mt. x X247-48	320	11
B569	Green Mt. x X247-30	33	3
B570	B24-58 x X247-48	95	12
B571	Mohawk x B24-58	222	59
B579	B24-58 x Katahdin	326	60
B620	Sebago x B24-58	137	64

NOTE: Seedlings B24-58, X247-30, and X247-48 averaged respectively 0, 1, and 2 per cent leafroll infection in the Highmoor Farm tests over a period of 5 to 7 years.

TABLE 28

Comparison of Crosses with Respect to Vines and Tuber Shape

Cross	Parents[1]	Year of introduction to Highmoor Farm test	Seedlings without leafroll 1946		Seedlings harvested 1946	
			Total	With poor vines[2]	Total	With poor-shaped tubers[3]
				Per cent		Per cent
B285	247-48 x Green Mountain	1943	29	24	22	64
B289	247-48 x Katahdin	1943	11	55	5	60
B298	247-48 x Houma	1943	44	27	32	13
B314	247-48 x Sequoia	1943	18	11	16	13
B410	750-10 x 247-48	1943	33	27	24	38
B420	1276-48 x 247-48	1943	53	28	38	8
B455	Sebago x 247-48	1944	10	50	5	60
B528	1276-185 x 1241-91	1944	34	56	15	7
B568	Green Mountain x 247-48	1945	284	50	141	47
B571	Mohawk x B24-58	1945	90	70	27	33
B579	B24-58 x Katahdin	1945	130	59	53	23
B620	Sebago x B24-58	1945	49	76	12	41

[1] Numbers designate seedlings that are resistant to leafroll in the Highmoor Farm tests.
[2] Discarding for poor vines was practiced in 1943, 1944, and 1945, but not so intensively as in 1946.
[3] Discarding for poor tuber shape was practiced in 1943, 1944, and 1945, but 1946 was a season more conducive to poor tuber shape than the others.

TABLE 29

Yields of Katahdin Potatoes When Treated Throughout the Season with DDT in Three Different Forms at Weekly or Biweekly Intervals

Treatment number	Form and amount of DDT	Machinery of application	Appx. rate of application per acre	Number of applications of DDT	Average yield per acre
					Barrels
1	Dust—5% DDT[1]	Power duster	35 lbs.	9	217.7
2	Dust—5% DDT	Power duster	35 lbs.	5	208.8
3	Spray—DDT Suspension 4 lbs. per 100 gal.[2]	Power sprayer Slosser boom	120-125 gal.	9	212 4
4	Spray—DDT Suspension 4 lbs. per 100 gal.	Power sprayer Slosser boom	120-125 gal.	5	206.7
5	Spray DDT Emulsion 1 qt. 32% miscible oil per 100 gal.[3]	Power sprayer Slosser boom	120-125 gal.	9	207.4
6	Spray—DDT Emulsion 1 qt. 32% miscible oil per 100 gal.	Power sprayer Slosser boom	120-125 gal.	5	211.9
7	Spray—Fungicide only[4]	Power sprayer Conventional boom	100 gal.	9	153.7

[1] Cuprous oxide dust + DDT.
[2] Cuprous oxide with 50% wettable DDT powder.
[3] Cuprous oxide plus DDT emulsion (32% DDT – Velsicol AR 60-65% Triton X-100-3%).
[4] Cuprous oxide.

Difference required for significance Prob. .05 = 19.7 barrels
.01 = 27.0 barrels

TABLE 30

Yields of Katahdin Potatoes When Treated Weekly with DDT from mid-August on Using DDT in Three Different Forms Applied with Three Different Types of Applicators

Treatment number	Form and amount of DDT[1]	Machinery of application	Appx. rate of application per acre	Number of applications of DDT	Average yield per acre
					Barrels
1	Dust—5% DDT	Power duster	35 lbs.	5	197.8
2	Spray—DDT suspension 4 lb. per 100 gal.	Power sprayer Slosser boom	120-125 gal.	4	187.1
3	Spray DDT suspension 4 lb. per 100 gal.	Power sprayer Conventional boom	100 gal.	5	180.2
4	Spray—DDT emulsion 1 qt. 32% miscible oil	Power sprayer Slosser boom	120-125 gal.	4	187.0
5	Spray—DDT emulsion 1 qt. 32% miscible oil	Power sprayer Conventional boom	100 gal.	5	184.1
6	Spray—Fungicide only	Power sprayer Conventional boom	100 gal.	9	155.7

[1] See Table 29 for description of materials used.

Differences required for significance. Prob. .05 = 18.8 barrels
.01 = 26.2 barrels

TABLE 31

The Average Numbers of Aphids[1] per Plant on the Basis of Three Whole Leaves per Plant

Treatments[2]	1	2	3	4	5	6	7
Aphis abbreviata							
7/16	.04	.7	.1	.1	0	.1	.5
7/26	.4	1	.2	.5	.1	.1	3
8/1	1	1	.5	1	.1	.4	8
8/14	9	10	5	5	3	4	113
8/20	19	37	10	17	9	28	567
8/23	24	30	8	17	4	13	625
9/12	30	45	10	22	3	7	612
Myzus persicae							
7/16	0	0	0	.01	0	0	0
7/26	0	.02	.01	.1	.01	.01	.5
8/1	.02	.02	.1	.03	.01	0	.7
8/14	2	2	1	1	2	2	62
8/20	20	25	15	17	22	23	376
8/23	23	29	15	18	18	14	428
9/12	4	7	1	1	1	2	411
Macrosiphum solanifolii							
7/16	.01	0	0	0	0	0	0
7/26	.1	.1	0	.1	0	.01	.2
8/1	0	.1	.01	.1	0	0	.8
8/14	3	2	1	4	1	1	1
8/20	9	10	8	16	5	10	83
8/23	14	14	9	16	7	5	101
9/12	5	7	3	6	2	2	57

[1] Includes winged aphids of which relatively few were present.
[2] See Table 29 for description of treatments and yields.
Treatments applied July 11, 17, 26, 31, August 6, 14, 21, 29, September 3 (and No. 1 only on September 11).

TABLE 32

The Average Numbers of Aphids[1] per Plant on the Basis of Three Whole Leaves per Plant

Treatments[2]	1	2	3	4	5	6
			Aphis abbreviata			
7/16	.1	.1	.3	.5	.3	.5
8/1	3	3	6	2	3	2
8/10	41	61	54	41	35	37
8/13	130	79	89	66	90	79
8/16	79	86	83	21	37	121
8/30	204	119	174	11	31	457
			Myzus persicae			
7/16	.1	0	.1	0	0	0
8/1	.7	.1	.8	.4	.6	1
8/10	14	19	6	9	20	26
8/13	83	52	21	20	38	51
8/16	45	39	26	13	25	79
8/30	54	19	15	7	11	378
			Macrosiphum solanifolii			
7/16	0	0	0	0	0	0
8/1	.2	.2	.6	.2	.1	.2
8/10	14	11	14	14	9	10
8/13	31	23	38	22	24	31
8/16	27	36	38	13	11	57
8/30	20	20	24	6	5	102

[1] Includes winged aphids of which relatively few were present.
[2] See Table 29 for description of treatments and yields.
Treatments applied August 14, 21, 29, September 3 (and Nos. 1, 3, 5 on September 11).

TABLE 33

The Effect on Yield and the Spread of Leafroll of Spraying Katahdin Potatoes with Different Fungicides and with Combinations of These Fungicides with DDT

Fungicide	Formula	Yield per acre[1] 1945		Increase from applying DDT		Leafroll in progeny[2]	
		Without DDT	With DDT[3]			Without DDT	With DDT[3]
		Barrels	Barrels	Barrels	Per cent	Per cent[4]	Per cent[4]
Bordeaux control	8-4-100	129	150	21	16	23	21
Basic copper sulfate	4-100	130	161	31	24	20	24
Basic copper arsenate	4-100	132	164	32	24	12	22
Fermate (ferric dimethyldithiocarbamate)	2-100	115	135	20	17	22	27
Karbam Z (zinc-dimethyldithiocarbamate)	2-100	132	155	23	17	17	27
Karbam Z and soap	2-100	126	149	23	18	16	31
Dithane (disodium ethylene bisdithiocarbamate)	2 qts., 1 lb. $ZnSO_4$ and ½ lb. lime	128	161	33	26	23	29
DDT no fungicide			124				
Unsprayed control		110		14	13	7	—

[1] Average of nine replicated two-row plots each 25 feet in length for each treatment.
[2] Present when progeny was planted the following season.
[3] Two pounds of 50 per cent DDT (1 pound of actual DDT) added to 100 gallons of spray material.
[4] Per cent of leafroll infected progeny based on readings from approximately 200 plants grown from tubers taken at random from the nine replicated plots of each treatment.

TABLE 34

Acreage of Potato Varieties Represented in the Florida Test for Three Years—1944-1946

Variety	1946-47				1945-46				1944-45			
	Acreage	Per cent			Acreage	Per cent			Acreage	Per cent		
		F[1]	T	O		F	T	O		F	T	O
Bliss	55	100	0	0	0				55	0	53	47
Chippewa	3385	59	36	5	2750	22	42	36	3600	7	15	78
Green Mountain	1828	75	22	3	3050	33	35	32	2500	32	35	33
Houma	63	100	0	0	78	5	35	60	17	18	59	13
Irish Cobbler	4033	84	15	1	3225	54	38	8	2150	18	37	45
Katahdin	5233	87	12	1	3500	56	41	3	1475	47	42	11
Mohawk	21	57	43	0	19	63	16	21	6	66	24	10
Pontiac	27	85	15	0	16	13	5	82	0.2	100	0	0
Russet	21	43	0	57	8	25	75	0	3	0	100	0
Sebago	551	83	17	0	700	35	49	16	945	16	48	36
Sequoia	11	36	64	0	10	25	0	75	60	5	8	92
Warba	13	100	0	0	11	55	45	0	9	0	0	100
Early Rose	0				0				0.1	0	0	100
Spaulding Rose	0				1	100	0	0	0			
Earlaine #2	0				0				64	0	0	100

[1] F = Foundation seed
T = Table stock seed
O = Out—not recommended.

TABLE 35

Samples of 1945 Green Mountain Potato Crop and Effect of Storage Temperature

Sample[1]	Days in storage[2] at					Av. temp.	Tubers with			
							Net necrosis		Stem-end browning	
	34° F.	38° F.	44° F.	50° F.	All temp.		Cull[3]	Total	Cull[3]	Total
						°F.	Per cent	Per cent	Per cent	Per cent
102	28			8	36	38	1	2	0	T[4]
105		28		7	35	40	3	5	0	0
108			28	7	35	45	8	10	0	T
111				35	35	50	10	13	1	6
104	43				43	34	1	2	0	0
103	28			14	42	39	1	5	0	0
107		43			43	38	2	3	T	T
106		28		14	42	42	3	7	0	0
110			43		43	44	8	10	0	T
109			28	14	42	46	7	10	0	1
112				42	42	50	10	17	2	6
113	56			8	64	36	1	3	0	0
116		56		8	64	40	3	5	0	0
119			56	8	64	45	8	10	1	5
122				64	64	50	11	12	10	30
115	70				70	34	1	3	0	0
114	56			14	70	37	1	5	0	0
118		71			71	38	4	8	0	0
117		56		14	70	40	3	7	0	0
121			71		71	44	9	11	1	2
120			56	14	70	45	8	9	1	3
123				70	70	50	10	12	9	23
124	84			7	91	35	1	2	0	0
127		84		7	91	39	3	6	0	0
130			84	7	91	45	9	10	1	6
133				91	91	50	10	10	14	32
126	100				100	34	1	3	0	0
125	84			14	98	36	0	3	0	0
129		99			99	38	4	6	0	0
128		84		14	98	40	4	6	0	0
132			99		99	44	9	10	2	9
131			84	14	98	45	9	9	3	10
134				98	98	50	10	10	16	36
135				99	99	50	10	10	15	34
136				126	126	50	8	8	17	34
202	28			9	37	38	4	8	0	0
205		28		9	37	41	7	13	0	0
208			28	10	38	46	23	26	0	0
211				37	37	50	23	26	T	T
204	43				43	34	2	5	0	0
203	28			15	43	40	4	10	0	0
207		44			44	38	5	9	0	0
206		28		15	43	42	11	16	0	0
210			44		44	44	22	24	0	0
209			28	16	44	46	22	25	0	0
212				43	43	50	28	32	1	1
213	56			8	64	36	7	16	0	0
216		56		8	64	40	12	16	0	0
219			56	8	64	45	23	26	T	1
222				64	64	50	31	32	2	3

TABLE 35—(Concluded)

Sample[1]	Days in storage[2] at 34° F.	38° F.	44° F.	50° F.	All temp.	Av. temp.	Tubers with Net necrosis Cull[3]	Net necrosis Total	Stem-end browning Cull[3]	Stem-end browning Total
						°F.	Per cent	Per cent	Per cent	Per cent
215	72				72	34	3	5	0	0
214	56			15	71	37	7	14	0	0
218		72			72	38	7	12	0	0
217		56		15	71	41	14	18	0	0
221			72		72	44	26	28	1	1
220			56	15	71	45	31	32	1	1
223				71	71	50	31	32	1	2
224	86			8	94	35	7	14	0	0
227		86		8	94	39	15	21	0	0
230			86	8	94	45	29	31	1	1
233				93	93	50	33	34	2	2
226	100				100	34	4	9	0	0
225	86			15	101	36	12	20	0	0
229		102			102	38	10	16	0	0
228		86		17	103	40	20	25	0	0
232			103		103	44	27	29	1	1
231			86	15	101	45	28	31	1	1
234				102	102	50	32	33	2	2
235				103	103	50	31	33	2	3
236				128	128	50	32	32	4	4

[1] Samples 102 etc. from field 1, 202 etc. from field 2.
[2] Periods in storage at different temperatures given from left to right as they occurred in the experiment.
[3] Cull net necrosis or stem-end browning is that which causes more than 5 per cent sliced-off waste.
[4] "T" means "trace" or less than 0.5 per cent.

TABLE 36

Effect of Tuber Size on Net Necrosis and Stem-end Browning Green Mountain Potato Crop of 1945

Field	Temperature[1]	Century[2]	Tubers net necrosis[3] Cull[4]	Mild[5]	All	Tubers with stem-end browning Cull[4]	Mild[5]	All	Ratio cull % to total % N.N.	S.E.B.
	°F.		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent		
1[6]	34	1	1.0	5.1	6.1	0	0	0	.164	—
		2	0.8	2.8	3.6	0	0	0	.222	—
		3	0.9	2.3	3.2	0	0	0	.281	—
		4	0.7	1.6	2.2	0	0	0	.318	—
		5	0.8	1.0	1.8	0	0	0	.444	—
		6	0.9	0.6	1.4	0	0	0	.643	—
	38	1	4.2	7.0	11.2	0	0	0	.375	—
		2	3.2	3.6	6.8	0	0	0	.471	—
		3	3.2	3.0	6.2	0	0	0	.516	—
		4	3.2	1.8	5.0	0	0	0	.640	—
		5	2.7	1.2	3.9	0	0	0	.692	—
		6	1.8	1.1	2.9	0	0	0	.621	—

TABLE 36—(Concluded)

Field	Temperature[1]	Century[2]	Tubers net necrosis[3]			Tubers with stem-end browning			Ratio cull % to total %	
			Cull[4]	Mild[5]	All	Cull[4]	Mild[5]	All	N.N.	S.E.B.
	°F.		Per cent	Per cent	Per cent	Per cent	Per cent	Per cent		
	44	1	12.6	2.0	14.6	0	2.0	2.0	.863	.000
		2	11.1	2.4	13.6	0.2	2.6	2.8	.816	.071
		3	8.7	1.9	10.6	0.3	4.6	4.9	.821	.061
		4	8.0	1.3	9 3	1.2	5.1	6.3	.830	.190
		5	4.7	1.2	5.9	1.6	3.1	4.7	.797	.340
		6	4.4	0.4	4.9	2.1	1.6	3.7	.898	.538
	50	1	16.6	1.9	18.5	1.3	21.3	22.5	.897	.058
		2	12.0	1.1	13.1	3.8	23.5	27.3	.916	.139
		3	9.4	0.8	10.1	10.0	18.3	28.3	.931	.353
		4	9.9	1.6	11.5	13.9	14.5	28.4	.831	.489
		5	6.1	1.8	7.9	16.5	8.1	24.6	.772	.671
		6	4.9	1.4	6.3	15.5	3.3	18.8	.778	.824
2[7]	34	1	7.4	14.7	22.1	0	0	0	.335	—
		2	6.6	9.2	15.8	0	0	0	.418	—
		3	6.9	7.0	13.9	0	0	0	.496	—
		4	5.3	4.1	9.5	0	0	0	.558	—
		5	4.3	2.1	6.4	0	0	0	.672	—
		6	5.1	0.9	6.0	0	0	0	.850	—
		7	3.1	0.2	3.3	0	0	0	.939	—
	38	1	18.2	12.6	30.8	0	0	0	.591	—
		2	13.0	8.3	21.3	0	0	0	.610	—
		3	12.8	5.6	18.3	0	0	0	.699	—
		4	11.0	3.4	14.4	0	0	0	.764	—
		5	9.3	2.1	11.4	0	0	0	.816	—
		6	8.1	1.2	9.3	0	0	0	.871	—
		7	6.3	0.2	6.6	0	0	0	.955	—
	44	1	37.4	5.0	42.4	0.1	0.1	0.2	.882	.500
		2	33.3	4.1	37.4	0.1	0.1	0.2	.890	.500
		3	25.6	3.4	29.0	0.6	0.1	0.7	.883	.857
		4	25.8	1.4	27.2	0.6	0.1	0.7	.949	.857
		5	21.7	1.2	22.9	0.9	0.2	1.1	.948	.818
		6	19.3	0.8	20.1	1.0	0.1	1.1	.960	.909
		7	16.0	0.2	16.2	0.8	0	0.8	.988	1.000
	50	1	42.5	3.8	46.3	0.1	0.4	0.5	.918	.000
		2	39.5	2.0	41.5	0.8	0.3	1.0	.952	.800
		3	35.0	2.1	37.1	1.5	0.3	1.8	.943	.833
		4	31.4	1.6	33.0	2.0	0.3	2.3	.952	.870
		5	23.0	0.6	23.6	2.4	0.1	2.5	.975	.960
		6	20.3	1.1	21.4	3.5	0.4	3.9	.919	.897
		7	17.5	0.4	17.9	2.9	0	2.9	.978	1.000

[1] Temperature at which all or most of the storage period of 35 to 128 days was spent.
[2] Each 100 tubers were selected as the largest appearing ones in the sample. Hence the first century were the largest, the second were the next largest, etc.
[3] Each figure represents 800 or 900 tubers, 100 from each of 8 or 9 samples.
[4] Cull net necrosis or stem-end browning is that which causes more than 5 per cent sliced-off waste.
[5] Mild net necrosis or stem-end browning is that which causes less than 5 per cent sliced-off waste.
[6] With seed-originated leafroll in 5 per cent of the hills.
[7] With seed-originated leafroll in 12 per cent of the hills.

TABLE 37

Effect of Level of Residual Potash in the Soil on Yield and Specific Gravity of Green Mountain Potato Tubers and on Concentration of Nutrients in the Plants—1946

Treatment (1927-44) as to green manure crop and for potatoes[1]	Exchangeable[2] K_2O in soil	Yield of tubers	Specific gravity of tubers[3]	Concentration of nutrients in fresh leaf rachises—Dry weight basis[4]			
				Potassium	Chlorides	Nitrates	Magnesium
	Lbs. per acre	Bu. per acre		Per cent	Per cent	Per cent	Per cent
2000 lbs. of 5-8-0 applied in 1945 and 1946							
(A) G.M. crop removed	170	215	1.098	1.10	0.76	2.97	1.43
(B) G.M. crop alone	236	365	1.101	2.97	0.46	2.28	1.63
(C) G.M. crop plus that from (A)	301	469	1.102	5.61	0.66	2.13	0.93
(D) G.M. crop plus straw	471	535	1.096	7.48	0.54	1.65	0.49
(E) G.M. crop plus manure	631	465	1.092	10.76	0.68	1.49	0.22
2000 lbs. of 5-8-10 applied in 1945 and 1946							
(A) G.M. crop removed	236	487	1.096	8.56	2.12	1.66	0.60
(B) G.M. crop alone	311	508	1.096	10.07	2.10	1.46	0.63
(C) G.M. crop plus that from (A)	377	517	1.093	11.67	2.16	1.59	0.63
(D) G.M. crop plus straw	574	544	1.088	14.47	2.44	1.27	0.29
(E) G.M. crop plus manure	1074	536	1.084	17.96	2.27	1.26	0.02

[1] Potatoes on all treatments received 2000 pounds 4-8-8 fertilizer in a two-year rotation with green manure crops. For treatment (D) 6 tons of straw and in (E) 20 tons of manure were turned under with the green manure crop before potatoes.
[2] Displaced from the soil with neutral normal ammonium acetate and expressed as pounds per 2,000,000 pounds of 2 mm. soil.
[3] A reduction of 0.005 in specific gravity is approximately equivalent to a reduction of 2 per cent in the starch content of the tubers.
[4] Nutrients soluble in acetic acid-sodium acetate solution at pH 4.8.

TABLE 38

Effect of Broadcast Applications[1] of Sulfur and Ammonium Sulfate on Reduction of Potato Scab at Aroostook Farm—1946

Treatments applied June 6, 1946	Acre Liming Rates Applied in 1935					
	6000 lbs.		4000 lbs.		2000 lbs.	
	Scab Index[2]	Reduction in scab index	Scab Index[2]	Reduction in scab index	Scab Index[2]	Reduction in scab index
		Per cent		Per cent		Per cent
None	58.8	—	44.5	—	14.4	—
300 lbs. Sulfur	51.3	12.8	33.6	24.2	5.2	63.8
600 lbs. Sulfur	53.3	9.3	22.1	49.8	3.7	74.3
900 lbs. Sulfur	35.7	39.3	21.5	51.1	3.7	74.3
400 lbs. Ammonium Sulfate	55.4	5.8	33.6	24.2	2.1	85.5
800 lbs. Ammonium Sulfate	33.0	43.8	29.4	33.5	2.5	82.6
1200 lbs. Ammonium Sulfate	24.5	58.4	22.5	48.9	0.7	95.1

[1] The treatments of sulfur and ammonium sulfate were superimposed upon an experiment in which the effect of liming and other factors had been studied since 1935. The above soil pH and scab index values have been adjusted on the basis of past variation in the plots so as to eliminate much of the error due to past treatment.

[2] Scab index values are obtained by sorting the tubers into various groups according to the percentage of the surface covered by scab lesions, weighing the tubers in each group, multiplying the weights by the mid-point of the percentage range of each respective group, and finally dividing the total of the products by the total weight of tubers in all groups.

TABLE 39

Effect of Rate of Fertilization with Nitrogen on Yield of Three Varieties of Potatoes—1946

Lbs. nitrogen applied in the corresponding mixtures, all applied 2000 lbs. per acre	Average yield at final harvest date—Bushels per acre		
	Cobblers	Katahdins	Green Mountains
	Third successive year in potatoes		
40 (2-8-10)	245	365	409
60 (3-8-10)	264	395	511
89 (4-8-10)	269	404	486
100 (5-8-10)	316	418	484
120 (6-8-10)	305	430	461
140 (7-8-10)	319	444	450
Least significant difference	34	27	61
	Potatoes following mammoth clover		
40 (2-8-10)	283	403	457
60 (3-8-10)	321	449	488
80 (4-8-10)	312	409	482
100 (5-8-10)	322	445	510
120 (6-8-10)	336	450	516
140 (7-8-10)	335	441	504
Least significant difference	31	32	Not significant

TABLE 40

Effect of Rate of Application of Potash Fertilizer on the Specific Gravity of Potato Tubers—1946

Pounds of K_2O applied with 2000 pounds of 5-8-0 per acre	Specific gravity of tubers				
	Test No. 1	Test No. 2	Test No. 3	Test No. 4	Average 4 tests
0 (5-8-0)	1.083	1.082	1.078	1.082	1.081
120 (5-8-6)	1.078	1.074	1.073	1.076	1.075
240 (5-8-12)	1.072	1.073	1.069	1.071	1.071
300 (5-8-15)	1.073	1.070	1.068	1.073	1.072

TABLE 41

Precipitation and Temperatures for the Year 1946 at the SCS Research Farm, Fort Fairfield, Maine

Month	Precipitation inches of water	Maximum temperature	Minimum temperature	Average maximum	Average minimum
		°F.	°F.		
January	2.27[1]	49	–26	2	0
February	1.95[1]	43	–19	2	–2
March	2.13[2]	66	– 7	46	2
April	2.22[2]	68	6	46	3
May	2.68	86	24	61	38
June	1.91	93	32	73	48
July	3.12	91	40	65	42
August	3.57	90	37	78	52
September	0.83	90	30	75	43
October	3.10[2]	80	24	60	33
November	3.63[2]	55	15	42	26
December	1.92[2]	44	–25	27	4
Total	29.33				

[1] Snow
[2] Rain and snow
Date of last frost—June 1, 1946.
Date of first frost—September 10, 1946.
100 consecutive frost-free days.

TABLE 42

Time Analysis of Equipment Operations in Producing 20 Acres of Potatoes—1946

	Listing	Plowing	Harrowing	Planting	Cultivating	Spraying	Digging	Miscellaneous
Hours	80	92	81	66	101	120	84	99
Per cent of total	10.9	12.8	11.3	9.2	13.8	16.6	11.7	13.7

35 per cent of the total tractor hours operation is for land preparation. The 13.7 per cent item under "Miscellaneous" includes such nonproductive work as plowing snow, hauling rocks, mowing field borders, etc.

The total of 722 tractor hours operation represents an expenditure of 36 tractor hours per acre of potatoes.

The above figures are actual field time and do not include time spent greasing, for repair, maintenance or major adjustments.

TABLE 43

1946 Potato Yields and Land Treatments
SCS Research Farm, Fort Fairfield, Maine

Field	Area	Slope	Yield	[1]Organic matter plowed under fall 1945	Rotation	Land treatment
	Acres	Per cent	Barrels per acre	Tons		
A1	3.26	12	165	Hay—1.9	Potatoes 3-yr. oats, hay	Contour planted Diversion terrace
A31	1.77	15	151	Sod—1.2	"	Interceptions and Div. terrace planted //[2] to Diversion
A30	1.51	16	144	Sod—1.0	"	As-A31 except intercep.
A4	0.75	17	156	No record	"	As-A1
B2-1	2.22	6	161	Rye grass—clover 1.8	Potatoes 2-yr. rye grass w/ clover	Rows straight approx. across slope Interceptions
B2 2	0.68	7	157	Rye grass—clover 1.8	"	"
C-1	1.20	5	162	Oats 1.23	{2-yr. fallow w/oats {Potatoes	Terraced—Planted // to terraces
C-3	0.98	6	198	Oats—2.43	"	"
C-5	1.03	4	148	Rye grass—.8	" w/grass	"
D	2.12	8	172	Crop residue—.5	Continuous potatoes	Div. planted // to div.
E1	1.61	4	166	Oats—2.84	2-yr. oats, potatoes	Terraced
E2	0.51	4	157	Oats 2.00	"	"
F1	0.79	4	137	Not measured	Continuous potatoes	"
Seed plot	2.5	6	100	Rye grass—clover 1.8	As-B2	As-B2 Early harvest

[1] Organic matter based on air dry material from triplicate yard square samples.
[2] // indicates parallel to.
All potatoes received 1800 pounds 6-9-12 fertilizer per acre at planting time. All operations, planting, cultivating, spraying, and harvesting comparable.
Fields E1, E2, and F1 are used as test areas for equipment operation.

TABLE 44

Average Yield of Tubers from Greensprouted and Non-greensprouted Plots (25 ft. rows, 10 replications)

Variety	Weight of tubers in pounds		Per cent increase from greensprouting	Significance of difference
	Green-sprouted	Non-green-sprouted		
Katahdin	15.3	9.2	66.3	Highly significant
Green Mountain	17.9	15.2	17.6	Highly significant
Cobbler	21.9	17.9	22.3	Highly significant

NOTE: The results of the 1945 tests, using only Katahdin seed, were similar to those of 1946, although the differences in yield were not as great.

TABLE 45

Effect of Irrigation on Yield of Houma Potatoes Grown at Different Spacings in the Row and at Different Rates of Fertilization

Central Maine—1946

	Irrigated	Non-irrigated	Percentage Increase (+) Decrease (—)
	Barrels	Barrels	Per cent
Per Acre Yield Various Sized Tubers			
Over 2½" diameter	67.4	15.2	341.9 (+)
2½" – 1⅞"	43.1	39.0	10.5 (+)
Less than 1⅞"	11.3	16.7	31.8 (—)
Total yield per acre	121.8	70.9	74.2 (+)
Per Acre Yield at Different Spacings			
6 inches	130.3	70.1	85.8 (+)
8 inches	123.9	70.6	75.5 (+)
10 inches	120.2	73.7	63.1 (+)
Per Acre Yield With Various Fertilizer Applications			
1000 lbs. per acre 8-17-16	103.7	54.4	90.6 (+)
1500 lbs. per acre 8-12-16	128.4	73.3	75.1 (+)
2000 lbs. per acre 8-12-16	142.3	87.1	63.3 (+)

TABLE 46

Yield and Specific Gravity Tests on 11 Potato Varieties and Seedlings That Were Grown in 5 Locations in Maine in 1946

Variety or seedling	Presque Isle			Patten			Ft. Kent	Hampden			Dover-Foxcroft				Mean for each variety		
	U.S. No. 1 per acre	U.S. No. 1	Specific gravity	U.S. No. 1 per acre	U.S. No. 1	Specific gravity	Specific gravity	U.S. No. 1 per acre	U.S. No. 1	Specific gravity	U.S. No. 1 per acre	U.S. No. 1	Specific gravity	Late blight tuber rot	U.S. No. 1 per acre	U.S. No. 1	Specific gravity
	Bu.	%	[1]	Bu.	%	[1]	[1]	Bu.	%	[1]	Bu.	%	[1]	%	Bu.	%	[1]
I. Cobbler	288	97	1.089	306	93	1.078	1.073	223	87	1.077	259	77	1.085	1.5	269	90	1.080
Gr. Mtn.	473	97	1.099	614	98	1.086	1.076	342	97	1.080	420	67	1.083	29.5	462	91	1.085
Katahdin	341	95	1.093	464	97	1.082	1.071	289	97	1.074	305	84	1.077	9.1	350	94	1.079
Chippewa	370	95	1.080	376	94	1.069	1.062	263	94	1.068	325	86	1.076	3.0	334	93	1.071
Houma	410	94	1.088	431	95	1.079	1.069	317	93	1.073	400	81	1.081	1.5	390	92	1.078
Sebago	353	95	1.093	565	97	1.080	1.076	267	95	1.071	410	90	1.082	1.7	399	94	1.080
Mohawk	423	98	1.103	483	99	1.085	1.079	299	99	1.079	307	82	1.085	16.2	378	95	1.086
Sequoia	448	97	1.090	695	98	1.074	1.065	366	97	1.067	372	58	1.068	38.3	470	89	1.073
Teton	416	99	1.088	553	99	1.082	1.069	269	97	1.067	338	86	1.077	9.1	394	89	1.077
Pontiac	471	97	1.083	542	98	1.074	1.062	270	97	1.065	379	88	1.073	7.1	416	89	1.071
Pawnee	290	91	1.088	298	94	1.078	1.071	253	92	1.077	333	78	—	10.2	294	90	1.079
B 69-16	407	99	1.092	601	98	1.082	1.065	398	96	1.075	492	92	1.083	trace	475	96	1.079
B 70-5	480	99	1.093	559	99	1.086	1.072	445	99	1.074	550	95	1.084	.0	509	98	1.082
Least significant difference 5 per cent level	54	—	.003	63	—	.004	.006	—	—	.066	—	—	—	—	—	—	—
Mean for each location	398	—	1.091	499	—	1.080	1.070	308	—	1.073	376	—	1.080	—	—	—	1.078

[1] Densities	Starch equivalent
1.060	9.5
1.065	10.7
1.070	11.7
1.075	12.9
1.080	13.9
1.085	14.9
1.090	16.1
1.095	17.2
1.100	18.2
1.105	19.3

TABLE 47

Average Potato Bin Sizes and Net Capacities by Production Areas in Aroostook County

Area	Length (ft.)	Width (ft.)	Depth (ft.)	Net capacity[1] Cu. ft.
		Farm Storage Houses		
St. John	29.1	12.3	12.3	4402.5
Presque Isle	33.9	12.3	10.3	4294.8
Ashland	42.5	11.5	9.3	4545.4
Houlton	34.2	10.7	10.3	3769.2
Average	32.6	12.2	11.0	4374.9
		Track Storage Houses		
St. John	26.1	8.8	12.5	2871.0
Presque Isle	25.4	9.1	10.6	2450.1
Ashland	24.7	9.1	13.7	3079.3
Houlton	24.5	8.9	11.2	2442.2
Average	25.6	9.0	11.5	2649.6

[1] Computed by multiplying length x width x depth of average size bins.

TABLE 48

Variations in the Capacities of Farm and Track Storage Bins in Aroostook County

Capacity (cubic feet)	Farm storage bins		Track storage bins	
	Number of storage bins	Per cent of total	Number of storage bins	Per cent of total
Less than 1000.0	9	2.4	25	4.5
1000.0 to 1999.9	64	17.1	201	35.9
2000.0 to 2999.9	84	22.4	190	34.0
3000.0 to 3999.9	67	17.9	72	12.9
4000.0 to 4999.9	54	14.4	33	5.9
5000.0 to 5999.9	27	7.2	17	3.0
6000.0 to 6999.9	22	5.9	8	1.4
7000.0 to 7999.9	12	3.2	5	.9
8000.0 to 8999.9	8	2.1	4	.7
9000.0 to 9999.9	11	2.9	2	.4
10,000 and over	17	4.5	2	.4
Total	375	100.0	559	100.0